TECHNOLOGY DEPT.

Power Plant ENGINEERING

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Your sons, husbands and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.

We, upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity.

Give us not only the needed implements of war, but the assurance and backing of a united people so necessary to hasten the victory and speed the return of your fighting men.

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THE POWER ENGINEERING AND MAINTENAN

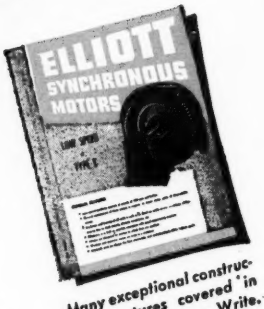
STEAM, COMPRESSED AIR AND REFRIGERATION FOR LARGE WAR PLANT • WHAT POWER ENGINEERS SHOULD KNOW ABOUT SLIDE RULES • CHEMICAL FEED SYSTEMS FOR WATER TREATMENT • CONTENTS PAGE 5

MAY, 1945

Two exceptional motors

Low-speed synchronous—Type E

- Operates at 450 rpm and below—
- Squirrel cage windings in rotor of famous Elliott diamond cage type where required—
- Windage and magnetic noises are kept to a minimum—
- Motors are specially adapted and built for their specific service—
- Efficiency as high as possible consistent with good engineering practice—
- Materials used are the best obtainable . . . workmanship is uniformly of highest standard—
- THESE ARE EXCEPTIONALLY STURDY MOTORS, RECOMMENDED FOR LOW-SPEED DRIVES, WHERE MANY YEARS OF SERVICE ARE CONTEMPLATED.



Many exceptional construction features covered in the new bulletin — Write.

ELLIOTT

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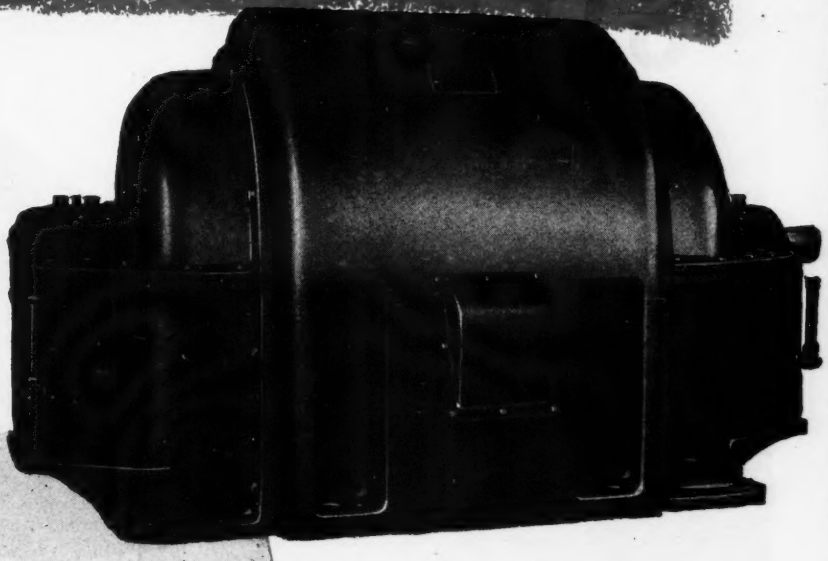

High-speed two-pole— splash-proof

- Smooth, streamlined appearance—
- Substantial cast iron frames and brackets—quiet, stiff, vibrationless—
- Rotor bearings rigidly braced from base—
- Rotor carefully balanced dynamically and statically—
- Rotor winding designed for the service required. Elliott diamond cage construction used where exceptional strength is needed—
- Substantial, roomy conduit box—
- Construction minimizes windage and magnetic noises—
- Controlled ventilation assures cool operation—
- A PARTICULARLY SERVICEABLE HIGH-SPEED MOTOR, BUILT TO ELLIOTT STANDARDS THROUGHOUT.

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Electric Power Department

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SPECTACULAR symbol of steam power, the Norfolk and Western system's new streamlined locomotives develop 6000 hp. and attain speeds in excess of 100 mph. Total weight of the engine and tender is 867,600 lbs.

In every type of steam generating plant—stationary as well as mobile—dependable, full-power output is possible only when lubrication is thoroughly effective. To assure this, more and more operators are using Texaco.

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Power Plant ENGINEERING

May 1945

VOLUME 49—NUMBER 5

Cover: An illustration of the many power applications that help keep America's war plants working round-the-clock. The squirrel-cage motor running this machine tool, through a protected V-belt drive is totally-enclosed and fan-cooled. Photo Allis-Chalmers.

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Ash and dust laden water enters the Hydro-Bin at the top; the water being removed by the overflow trough at the top, decanting elements at the sides and a water collecting gate at the bottom of the bin. Commercially dry refuse remains in the bin, for unloading into cars or trucks. Water removed from the bin can pass into a sewer or it may go to a storage tank, as illustrated, for recirculation through the Hydrojet System of Ash Removal or the Hydrovac System of Dust Removal. Hydroseal Pumps are used for pumping refuse into the bin and for recirculation of water. . . . The Dewatering Hydro-Bin is equipped with a steam manifold around the discharge gate, to insure operation in sub-freezing temperatures. Our nearest representative will gladly give you full information about this and other methods of refuse disposal available where Hydrojet and Hydrovac Systems are used.

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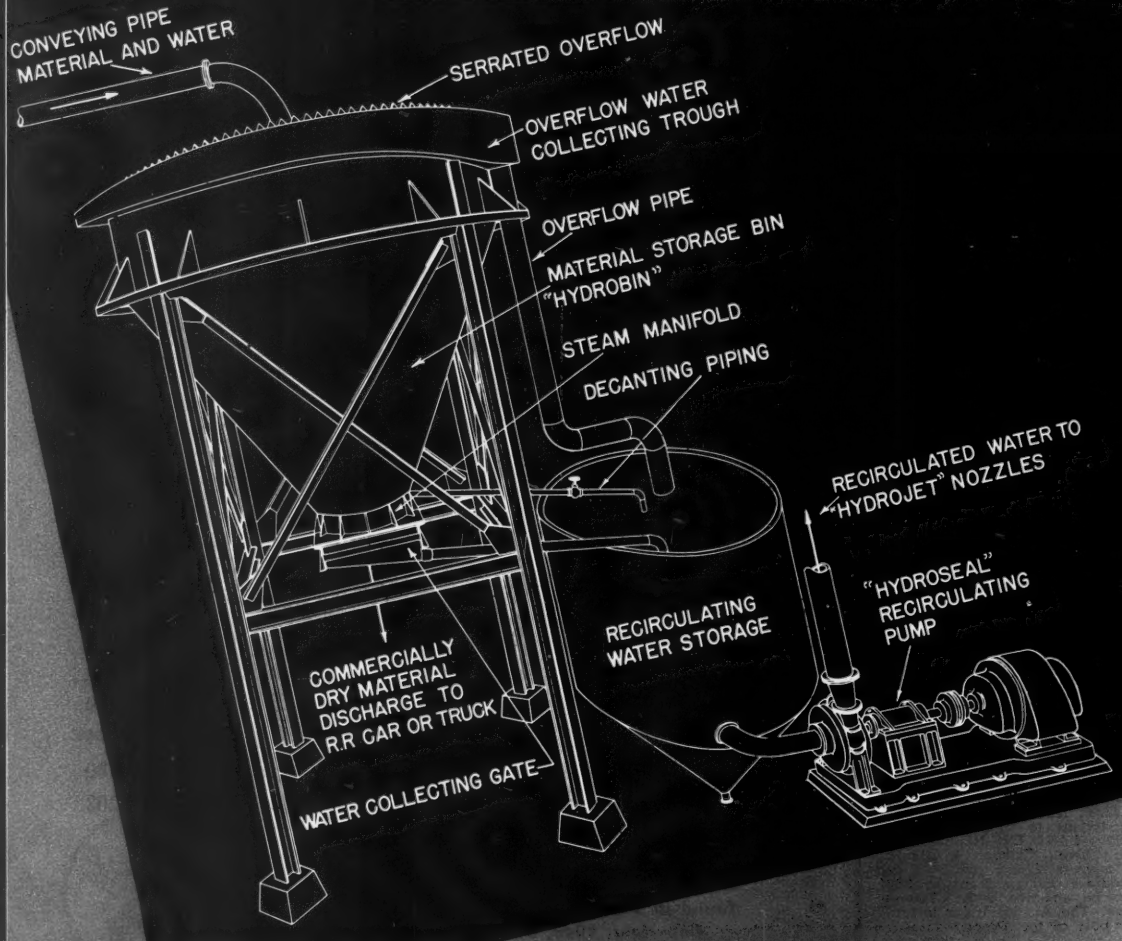

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Front Lines—

NEW MATERIALS derived from wood are being produced under new names at an amazing rate, according to Professor Alfred H. Bishop of the New York State College of Forestry, Syracuse University, because chemistry and the woodworking industries are moving so fast in the field of research and discovery. Such words as "compreg", "impreg", "papreg", "tekwood", "staypak" and "Arboneeld", are looming large on the horizon of business.

RECOGNITION of the facts that no iron or steel pipe now economically available can be expected to last long in some soils, and that protective coatings usually only delay corrosion, has emphasized the importance of other methods of protecting underground pipe. Most promising is an electrical method. If electrical connections are so made that the current flows to the pipe line, the pipe will be protected from corrosion. This is done in many installations by supplying energy from a power plant. Considerable use is also made of zinc anodes electrically connected to the pipe lines. In 1941 the Bureau of Standards began a series of field tests to determine the conditions under which this method of protection may be effective. (Technical News Bulletin 296, December, 1941.)

GENERATIONS of English and American children have grown up with memories of singing the old folk tune, "Here We Go Round the Mulberry Bush." But in this war the word "mulberry" has had a connotation that was definitely not child's play. For months, a something or other that was marked *No. 1 War Secret* was referred to continually as "The Mulberry," in all written, radioed or spoken messages, in the preparations for the invasion of Europe. It finally turned out that the mulberry was nothing more or less than the fabricated floating harbors and breakwaters that formed harbors for the landing crafts on the beaches of France.

IN RECENT YEARS because of the pre-war breakdown of our system of production and distribution, as evidenced by mass unemployment, we have been greatly preoccupied with economic problems. We have set full employment and full production as our goals. However, we must not lose sight of the fact that those goals should be attained through the democratic process. Democracy itself is an objective vital to our economic and political well-being. Today our Congress has a great opportunity by strengthening itself so that it can better our Government and thus make possible the achievement of both our economic and our political goals." These are the first sentences in the preface to Bulletin No. 39 entitled, Strengthening the Congress, by Robert Heller, published by the National Planning Association, 800 21st Street, N. W., Washington 6, D. C.

IF PRESSURE of the European war subsides by June, some $2,000,000,000 worth of construction can be completed in the Middle West and East this year, according to Thomas S. Holden, president of F. W. Dodge Corp, as reported recently by John Jenkins in the Chicago Daily News. Actual planned work ready for contract on heavy construction, non residental and residential building now amounts to $4,131,303,000 in the first postwar year, with new projects piling up at the rate of $21,000,000 a day right through to X-Day.

SMALLEST as well as biggest mass-produced units in aviation are manufactured by The Glenn L. Martin Co. Maker of the JRM-Mars, biggest plane in mass production today, the Martin Co. also produces a minute vibration detector weighing only two ounces which allows engineers to detect and measure vibration and shock wherever they may be found. Relations between them are closer than might be expected of two extremes. Vibration detectors, attached to wings and fuselage during test flights, helped supply advance flight data that led plane designers to "beef up" the 120-ft Mars hull to its present structural strength.

ANOTHER CHAMPION cold-water-thrower-on-postwar-fantasies turns out to be C. B. Veal, manager of the Co-ordinating Research Council, related to both the SAE and API. According to Bert Pierce in the New York Times, Mr. Veal thinks that dreams of a postwar high-octane fuel that will propel a car 30 or 50 miles on a gallon are just that—dreams. To use the new high-octane fuels effectively, high compression ratios and, as a result, special mechanical design, are necessary. A small high-octane prototype aircraft engine for automobiles, built to withstand the loads, would cost, as does the present aircraft engine, ten times as much per pound to build as the current mass-production automotive engines suitable for fuels of the prevalent octane number. Moreover, such an engine would be much noiser than the American motoring public would tolerate. Mr. Veal says more economy is to be sought in improved lubrication and improvements in construction materials and details.

MORE THAN 2,000 veterans of World War II have been employed by Ford Motor Co. dealers as a result of the training program being conducted throughout the country. To encourage veterans to work toward ownership of their own business, a plan was recently inaugurated whereby any returning veteran may apply for an earn-while-you-learn, full-paying "apprenticeship" through any Ford dealer in the United States.

IT HITS LIKE A BOMB—In the early hours of World War II, the British found that even their most powerful battleships were paralyzed by near misses. The electrical power systems were completely knocked out, due to damaged control. An exclusive Westinghouse design is a shock machine for testing circuit breakers, which led to the manufacture of new breakers that would not trip even under full load as a result of shock impact.

WE HAVE TOLD YOU about the spinstrometer and the oxometer, but did you read about the stinkometer in the Business Week for March 3? It was originally developed by the Hooper Foundation to replace the professional smeller in canneries. But the human nose is not infallible, says Business Week, and even when the nose can detect a foreign odor about the fish it is not always possible by olfactory judgment to determine how great is the deterioration that has taken place. Yeah, and besides, you can't tell how rotten the fish is just from the smell So you send it to a laboratory and have it measured with the stinkometer. Just why it is desirable or necessary to determine the degree of rottenness is still a mystery to us.

A NEW FIVE-YEAR RESEARCH program is outlined in considerable detail in a recent publication of Bituminous Coal Research, Inc., 803 Southern Building, Washington 5, D. C. This proposed program includes research in residential heating, industrial and commercial steam uses, industrial non-steam and special uses, coal, combustion and ash, carbonization, gasification, preparation, transportation and handling, railroad fuel and locomotive development, chemicals from coal, mining problems and technical service. Already extensive plans are being made, according to BCR, for a program of research to be carried out under the sponsorship of six of the leading railroads co-operating with BCR. A pulverized-coal-fired, high-pressure steam locomotive is being built for a group of nine railroads who are sponsoring its development with a fund of $1,500,000. The new engine will be built by the General Electric Company using a B & W water-tube boiler and is expected to develop 5400-hp with a turbine electric drive. High steam pressure and temperature will be employed. Looking into the not-too-distant future, engineers are working on a coal-fired gas turbine as a possible means of locomotive propulsion.

REHIRING Your Country's Veterans is the title of Analysis No. 38 published by Research Institute of America, 292 Madison Avenue, New York 17, N. Y. The book discusses in detail your rehiring obligations under the law, the meaning of "changed circumstances," solving seniority questions, unions and veteran re-employment, planning a personnel policy for veterans, handling the disabled veteran, how to keep key employees.

HOLD THAT ACID—Glass normally will resist all chemicals except hydrofluoric acid, and now a glass which will avoid even this fault is about to become commercially available. It is based on phosphorous pentoxide instead of silica and was developed specifically to resist hydrofluoric acid, now encountered increasingly in laboratories and plants, says the Industrial Bulletin of Arthur D. Little, Inc.

WANT TO RENT A BOILER? A vertical 55 to 90-hp boiler can be rented for $125 per month or $42 per week or $10.50 per day. A horizontal locomotive type boiler 125 to 175-hp will cost you $200 per month, $67 per week or $17 per day. Or perhaps you would like to rent a derrick. There is a choice assortment of these, such as circle swing, stiff-leg steel and tripod derricks with all sorts of hoist arrangements. A 20 ft length of 4-in. hose will cost you $1.20 per day or $4.80 per week, or $14.50 per month. How about renting a nice rubber-tired wheelbarrow for $5 a month or $2 a week or $.50 a day? Concrete mixers all the way from $3 to $17.50 a day. Full details and prices listed in compliance with the OPA Regulations published at $2 by the Rental Committee, Associated Equipment Distributors, National Press Building, Washington 4, D. C.

IN THE DETAILED DESCRIPTION of Grand Coulee Dam published in the April issue, you doubtless noticed brief mention of the stilling basin at the toe of the dam. There are some interesting details in the construction of this basin that could not be given in our article. They are discussed in detail, however, in an article entitled, Floating Repair Plant for Grand Coulee Dam, by R. G. Skerrett in the March, 1945 issue of Compressed Air magazine. The method of cleaning this stilling basin when the structure has been unwatered is extremely interesting. A caisson is being built that can be floated into the basin and sunk into place in the stilling basin to afford a platform for work on the structure.

THE RECENT FLURRY of interest among certain of the technical magazines in the subject of isometric drawing for engineers reminds us that some nineteen years ago we published in *Power Plant Engineering* an article giving all the fundamental principles, directions for laying out graph paper and black boards for performing isometric drawing and so on. This article appeared on page 541 of the May 1, 1926, issue of *Power Plant Engineering*. Its author, V. L. Sherman, was one of the first to advocate it as a practical method of drawing piping and first used it in his work as a teacher of drawing at Lewis Institute.

JET ENGINE production on a volume schedule for AAF combat operations is underway at the General Electric Co. second largest wartime plant at Syracuse, N. Y., it has been announced with approval of the War Department. Completion of the first of the superpowerful G-E Jet engines recently at the Syracuse plant actually marked the beginning of mass production in the United States of this new motive power unit, which drives planes at lightning-like speed at altitudes more than six miles above the earth.

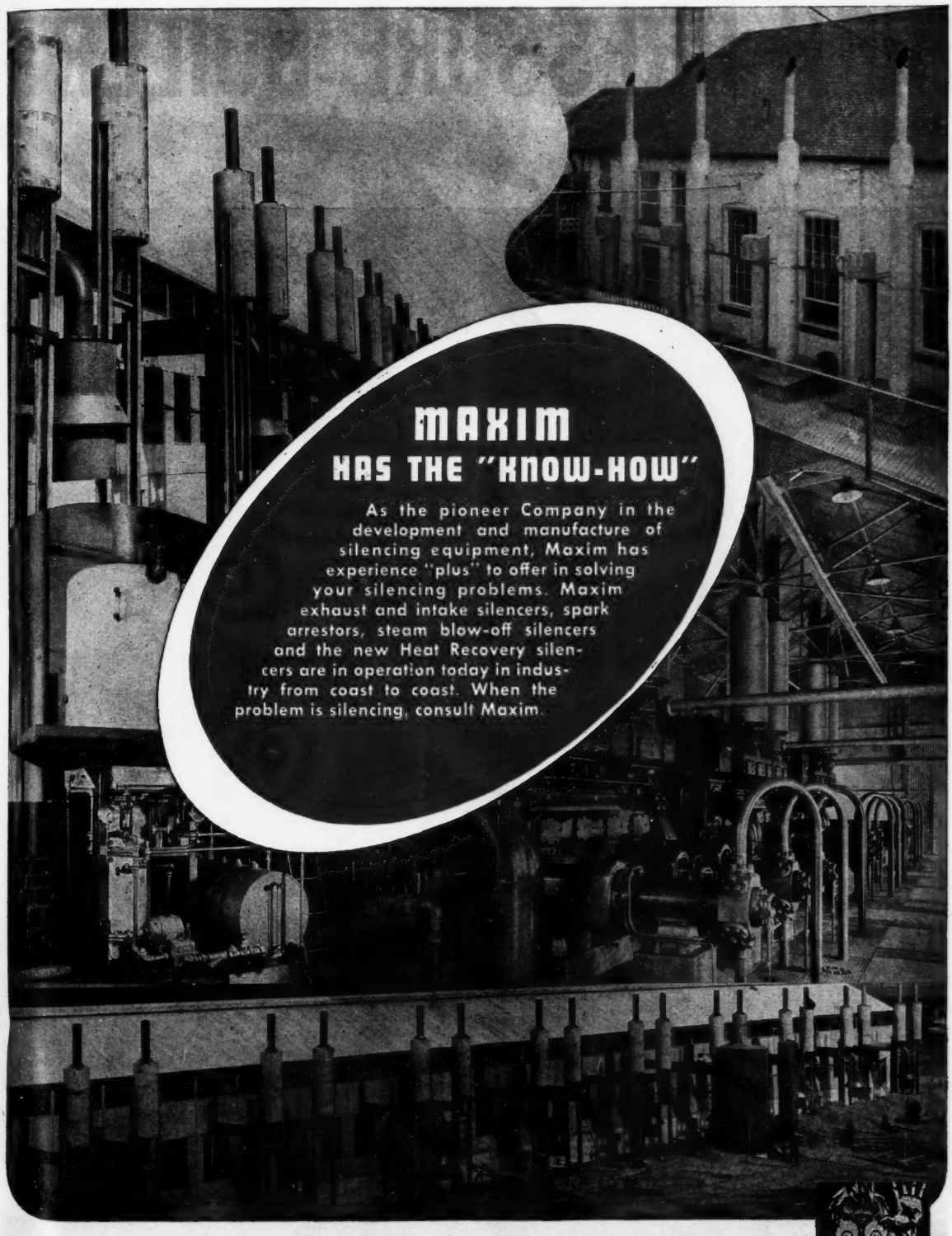
BUSINESS AND INDUSTRY are making steadily increasing application of visual education techniques to speed training and re-training of workers and in promoting other phases of activity, it is disclosed in an extensive survey made by the Victor Animatograph Corp., Davenport, Iowa. The survey revealed that virtually every major manufacturer of war goods materiel is utilizing 16-mm sound motion pictures for job training, to teach new techniques and visualize general operational problems.

SOMETIMES NATURE provides the solution to a modern problem. Many readers will recall seeing the maple seed which slowly falls to earth in a flat spin around its center of gravity located in the mass of the pod. The Army Air Force has designed a device which looks like the maple seed and operates in the same way, to replace parachutes used to deliver supplies. Approximately 65 pounds of supplies can be stored in the container which is the counterpart of the maple pod. Drift is negligible and accuracy is greater than when parachutes are used.—Ohmite News.

FLUORESCENT LAMPS LAST LONGER if you let them burn continuously. The reason, explains the Westinghouse Lamp Division, is that each time one of these tubes is turned on electrons "nibble" at the tips of the electrodes until the light-producing arc is struck. Frequency of starts, on the other hand, does not affect an incandescent lamp's longevity since it fails because the tungsten filament evaporates at incandescence until it finally melts.

IF STATISTICS count for anything, says the Rural Electrification Administration, over $700,000,000 will be spend to put plumbing on farms which have electricity today and on farms and other rural dwellings which will be electrified under the proposed National 5-year Postwar Rural Electrification Program.

A REVISED Reading List for Junior Engineers has been issued by the Junior Committee on Professional Training of the Engineers' Council for Professional Development and is now available for distribution. It covers natural science, philosophy, including religion, economics and sociology, psychology, business and industrial management, literature, including poetry, essays and fiction, history, biography, travel and the fine arts. Copies from the Engineers' Council for Professional Development, 29 West 39th St., New York 18. Price, 10 cents each, 5 cents in lots of 50 or more.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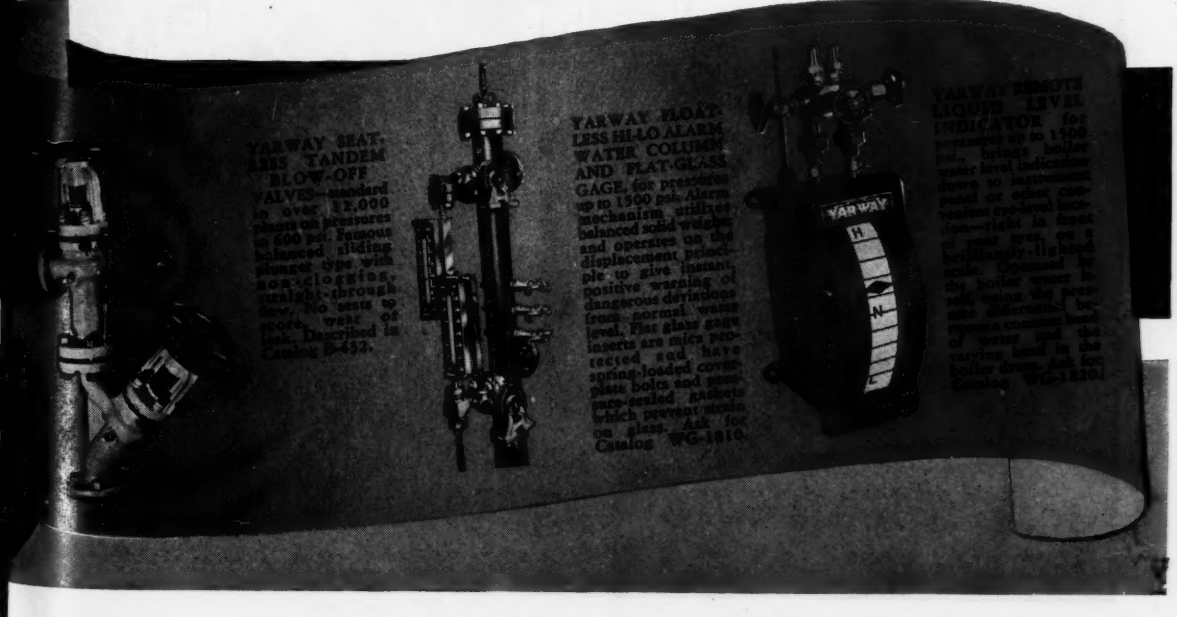

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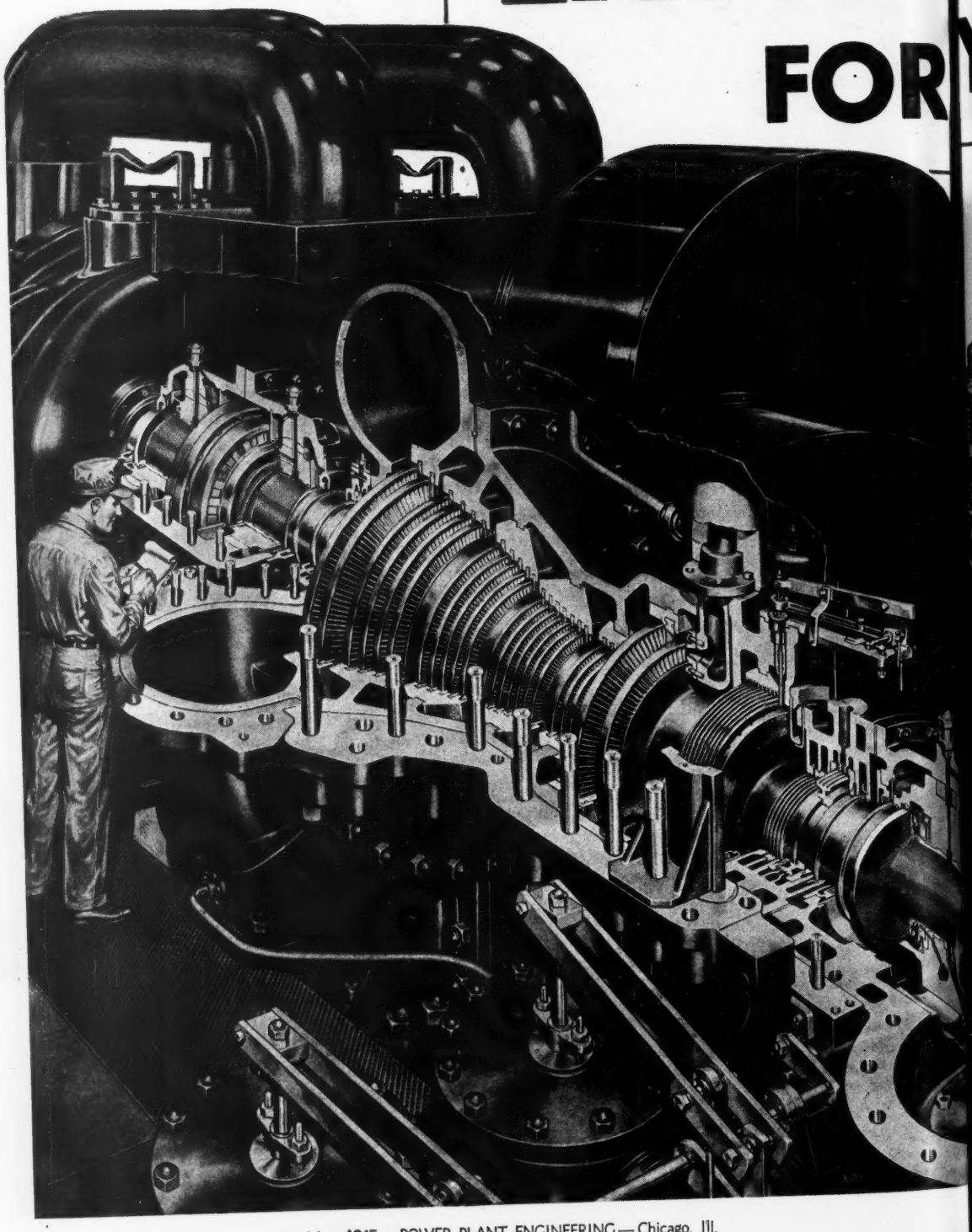

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"Why shouldn't I leave the floor?

These boilers have Hagan Control!"

When the Hagan engineer and a prospective customer came into the boiler room, there wasn't an operator in sight.

Yet, all five boilers were on the line, generating over a million pounds of steam an hour. They were burning blast furnace gas, automatically supplemented by pulverized coal, and supplying power for the entire mill. Signal lights flashed on and off, indicating the operation of burners . . . fans speeded up and slowed down in accordance with load variations . . . flow meters indicated that the boilers were handling a widely fluctuating load.

Finally, in a corner partitioned off as an office, the visitors found one man eating his lunch and reading a newspaper. The visiting engineer expressed his astonishment at the sight of all this intense activity without at least half a dozen operators in attendance.

But the man in charge was unperturbed. "Why shouldn't I leave the floor?" he said, "These boilers have Hagan Control."

This complete confidence in Hagan Control is characteristic of men who use it. To them it is a dependable tool. They use it with the confident familiarity that a good mechanic feels for his favorite wrench or screwdriver.

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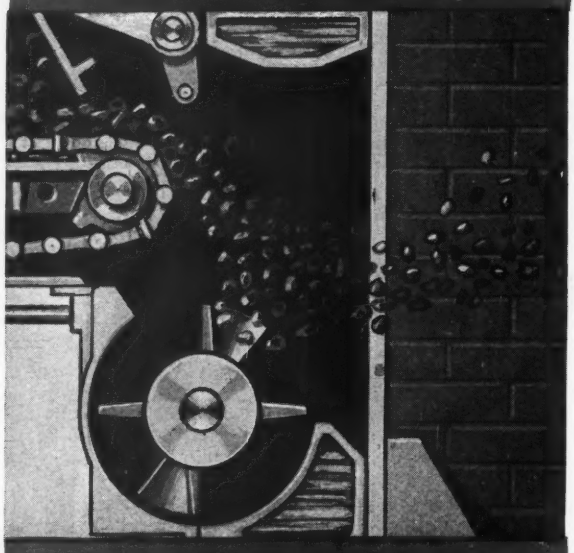
HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader



MORE STEAM at LOWER COST

LOOKING FOR a way to trim your fuel costs and boiler room operating expenses? Then you'll surely be interested in every feature of the Æ Perfect Spread Stoker—from its "streamlining with a purpose" to its "crossfiring" principle of combustion.

This modern, dependable stoker efficiently burns any kind or grade of solid fuel, wet or dry, including by-products and plant refuse. Maximum heat from every pound of fuel means more steam at very worthwhile savings. In operation, the stoker is extremely clean and quiet, answering steam demands instantly. It puts an end to many wasteful boiler room practices.

You may find in these and other important advantages the way to cut *your* fuel bills and boost operating efficiency. Write today for the new Æ Perfect Spread Stoker bulletin.

Overthrow ROTOR
SPREADS PERFECT FUEL BED

Over-the-rotor feed covers the entire grate area with a "Perfect" fuel bed and causes less wear on the rotor and housing. The uniquely designed and balanced Æ rotor spreads fuel perfectly, the fines burning in suspension and the heavier particles dropping to the grate for thorough combustion. This rotor is an exclusive feature not found in any other stoker.

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

Æ PERFECT SPREAD STOKER

AMERICAN ENGINEERING COMPANY

Subsidiaries: COCHRANE CORPORATION, FARADAY ELECTRIC CORPORATION

PHILADELPHIA 25, PENNSYLVANIA

A SURE WAY TO BE SURE YOU'RE RIGHT

HOW MANY types and makes of stokers should you consider when specifying new power plant equipment? Two? Four? Eight? To be absolutely *sure* you're right, you'll no doubt want *all* the information you can possibly get on *all* the latest stokers.

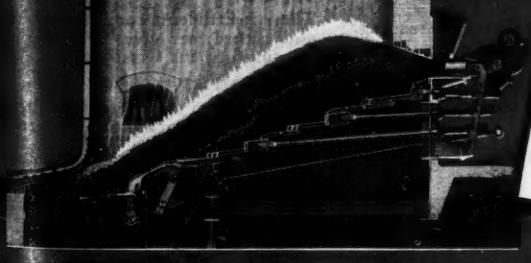
That's why we believe you will want to know about the *improved* Taylor Stoker. It is not an untried, untested stoker, but one with a solid 39-year background of highly efficient service all over the world. Now, sweeping improvements have been made that rank it as a stand-out stoker for dependable, low cost steam generation . . . based on *today's* requirements . . . and built to *tomorrow's* needs.

You'll get a great deal of valuable information from the new Type "R" Taylor Stoker booklet, which details every improved feature and its advantages to *you*. Write for it *today*.

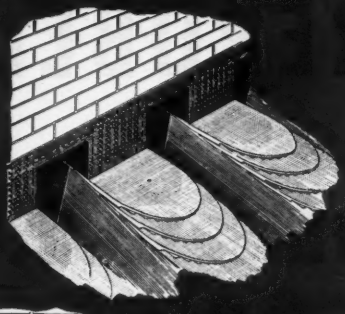
IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

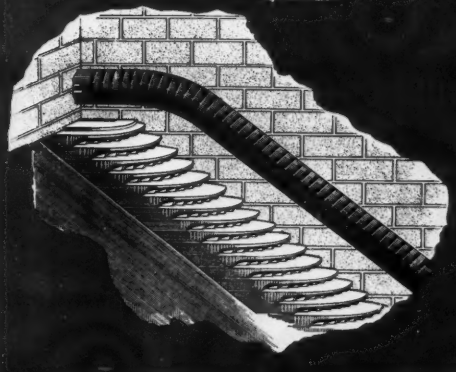
YOU NEED THIS BOOKLET

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.



ANOTHER IMPROVEMENT IN THE TYPE "R" TAYLOR STOKER





AIR COOLING REDUCES SLAG FORMATION

Front Wall Air Boxes, Side Wall Air Nozzles and Half Tuyeres of the Taylor Stoker discharge continuous, uniform air screens that reduce slag and clinker formation on furnace walls. This increases operating efficiency and economy.

Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

AMERICAN ENGINEERING COMPANY

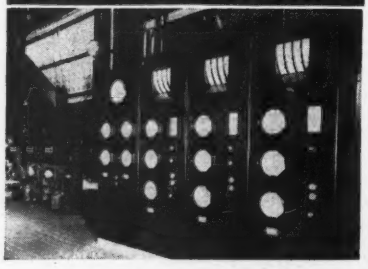
Subsidiaries: COCHRANE CORPORATION, FARADAY ELECTRIC CORPORATION

PHILADELPHIA 25, PENNSYLVANIA

Install

REPUBLIC INSTRUMENTS and CONTROL EQUIPMENT

COMBUSTION CONTROL



All Sizes of Boilers All Types of Firing

Low steam costs are the result of high boiler efficiency. Daily performance at test efficiencies will result from the installation of a Republic combustion control system. They are designed for all sizes of boilers and all types of fuel firing equipment.

CONSTANT STEAM PRESSURE

Automatically maintains a constant steam pressure by controlling the fuel and air input to the boilers in balance with the boiler load.

EFFICIENT COMBUSTION

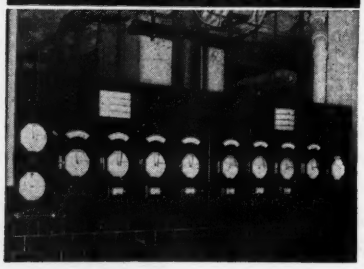
Automatically maintains maximum combustion efficiency over entire range of boiler rating, by controlling simultaneously the fuel and air input to boiler in measured proportions and in a fixed ratio.

LOAD DISTRIBUTION

Automatically distributes load equally among all the boilers, or the load can be distributed between the boilers as desired.

WRITE FOR DATA BOOK No. S-21

FLOW METERS



For Measuring the Flow of Steam-Water-Gas-Air-Oil

Do you have a means for easily and quickly checking the production and distribution of these power plant services? Do you know how much you are paying for steam or how economically it is being used? Republic flow meters will give you all the production and maintenance information you need in order to detect leaks and improve methods.

WORKING PRESSURES

Republic meters are available for all working pressures up to 5000 lb. per sq. in.

RANGE EASILY CHANGED

The range of a Republic meter can be easily and quickly changed by merely changing the range tube.

READING INSTRUMENTS

The Republic indicator, recorder and integrator operate independently of each other and can be supplied separately or in combination. They are remote reading.

EASILY READ

The indicator scale and the recorder chart all have uniform graduations and are direct reading. The integrator has a large cyclometer type dial.

WRITE FOR DATA BOOK No. 701

BOILER INSTRUMENTS

Eliminate Guesswork in Boiler Operation

Republic boiler instruments provide the operator with continuous performance records, which are the only reliable guide to efficient boiler operation.

STEAM FLOW METERS

Remote-reading indicators, recorders and integrators measure flows of steam and feedwater.

BOILER METERS

Records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

DRAFT INSTRUMENTS

Indicating and recording types in single or multiple units for all pressure or draft ranges.

CO_2 METERS

These instruments continuously indicate and record per cent CO_2 in flue gas measured by the Orsat method.

THERMOMETERS

Long-distance expansion-type thermometers with single or multiple pen recorders.

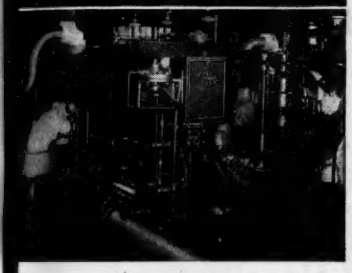
WRITE FOR BOILER METER DATA

REPUBLIC
INSTRUMENTS
AND CONTROLS

TO INCREASE Today's Steam Production

TO DECREASE Tomorrow's Steam Costs

REGULATORS



For Controlling Pressure Flow-Level-Speed

Republic regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

SENSITIVITY

Republic regulators can be made sensitive to changes of less than 0.001 inch of water.

SPEED

Republic regulators can be made to meet any speed requirement up to one full stroke in 2.4 seconds.

STABILITY

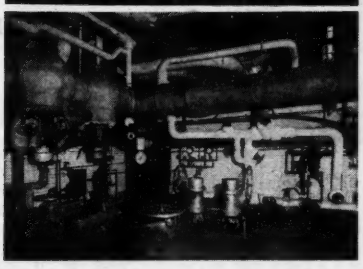
The patented Republic stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

POWER

Standard Republic power cylinders will deliver from 360 to 5600 foot pounds per stroke.

WRITE FOR DATA BOOK No. S-13

DESUPERHEATERS



Designed to Meet Your Special Requirements

Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with the rugged, simply-controlled Republic desuperheaters described below.

RATIO TYPE

This desuperheater is a self-supported venturi in which the desuperheating water, completely evaporated at all flows, is controlled by the steam flow in the correct proportion to reduce the steam temperature to the required value.

RATIO TANK TYPE

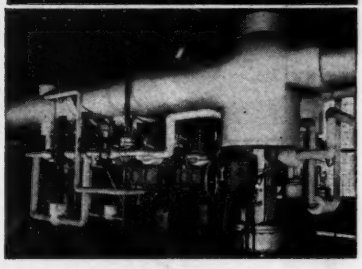
This unit is similar to the ratio type except that a water tank is added to give emergency water reserve.

STEAM ATOMIZING TYPE

In this desuperheater, built for extremely wide range operation and zero pressure loss, the desuperheating water is completely atomized at all rates of flow by a small quantity of high-pressure steam.

WRITE FOR BULLETIN No. S-30

VALVES



Regulating and Pressure Reducing

For your key jobs, where valves must not fail—where they must continuously and accurately regulate the pressures and flows of steam and water on which other vital processes depend—Republic valves give you the dependability you need.

ANY STEAM CONDITIONS

These valves are of the gradual-opening, high-lift, double-seated type, lever or hydraulic-operated, built to A.S.A. standards for steam conditions up to 1500 lb. per sq. in., 950 F and capacities up to 1,000,000 lb. of steam an hour.

STABLE REGULATION

Republic valves will regulate accurately from maximum flow down to 2 per cent of maximum.

CUSTOM MADE CONSTRUCTION

Republic valves are built for any piping condition, with inlet and outlet sizes proportioned for specific pressure reductions. Special steels are used, depending on service requirements.

ONE-PIECE STEM

Valve stem and discs are machined from a single stainless steel forging.

WRITE FOR BULLETIN No. S-40

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago 47, Illinois

With DIAMOND AUTOMATI

JUST PUSH A BUTTON

and the Automatic Control makes sure that all Soot Blowers operate in Proper Sequence and at the Right Speed . . . none can be overlooked. CORRECT CLEANING IS ASSURED AND BOTH FEED WATER AND LABOR ARE SAVED.

Just push a button . . . that's all you do to clean the entire boiler, superheater, economizer, and air heater (whether soot blower elements are fixed or retracting). All blowers then operate in proper sequence and at the correct blowing speed. No blower can be overlooked or incorrectly operated by a careless operator. This automatic operation entirely eliminates the need for an attendant.

The program panel shown above controls both retracting and nonretracting blowers arranged in three groups; any desired number of groups can be had when system is designed. One "start" button controls all groups, but any group can be operated independently of other groups if desirable by simply throwing a switch on the panel. Blowing sequence of the units in any group can also be easily altered to suit changed conditions.

Compressed air has a greater density than steam and therefore provides better cleaning. The air is discharged from permanently installed elements (see bottom of right-hand page) in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time eliminates stack discharge nuisance and permits use of a much smaller compressor.

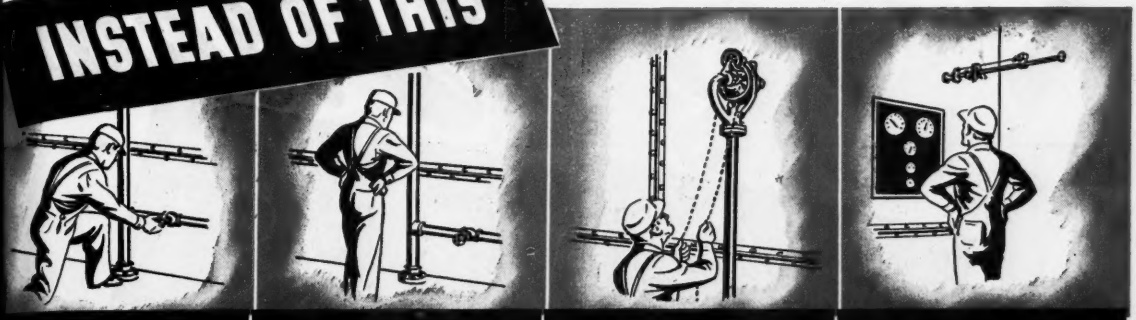
Diamond Automatic Sequential Air Soot Blowing Systems have been in very successful central station use since 1940. For further information, write for Bulletin No. 956 which illustrates and describes an installation on a 900,000 lb/hr boiler in a modern eastern central station.

DIAMOND POWER SPECIALTY C

DIAMOND SPECIALTY L

SEQUENTIAL AIR SOOT BLOWING

INSTEAD OF THIS

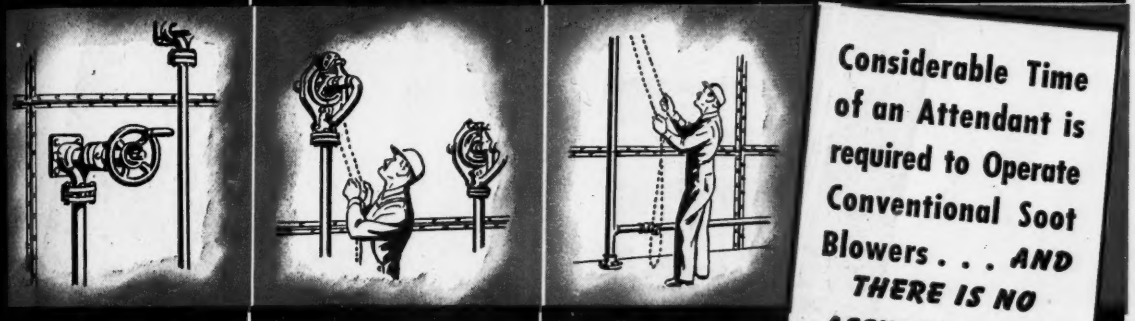


1 Opens Drain and Main Steam Valves

2 Drains and Warms Up Piping

3 Operates Blower No. 1 Too Fast

4 Operates Long Retracting Blower No. 2



5 Forgets to Operate Blower No. 3

6 Operates Blowers No. 4, 5, etc.

7 Closes Main Steam Valve

Considerable Time of an Attendant is required to Operate Conventional Soot Blowers . . . *AND THERE IS NO ASSURANCE THE WORK WILL ALWAYS BE CORRECTLY DONE!*

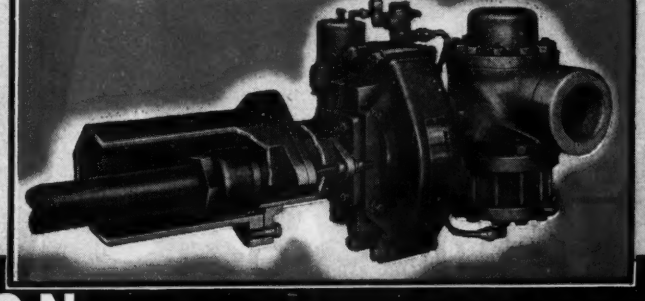
OTHER ADVANTAGES of DIAMOND Automatic Sequential AIR SOOT BLOWERS

NO FEED WATER MAKEUP—Using compressed air instead of steam as the cleaning medium, there is no condensate loss due to soot blowing. This is particularly important where makeup water is a problem.

SAVES FUEL—Experience gained during several years' operation on a number of installations indicates that automatic sequential air puff soot blowing uses only ⅓ to ½ of the energy from the coal pile that is needed for steam blowing.

REDUCES MAINTENANCE—Experience on two 900,000 lb/hr boilers placed in operation in 1940 and one 900,000 lb/hr and one 550,000 lb/hr units installed in 1942 has proved the maintenance cost is unusually low.

ELIMINATES PIPING INSULATION—When air is used for cleaning, the soot blower piping is not insulated.

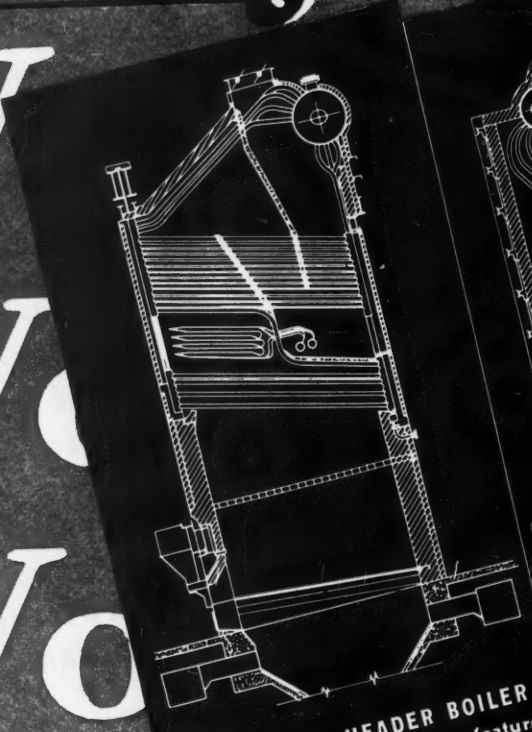


At right is the Diamond Air Puff Soot Blower having element permanently installed inside the setting; various types of retracting soot blowers are also used in the Diamond Automatic Sequential Air Soot Blower System.

Y CORPORATION • DETROIT 31, MICHIGAN

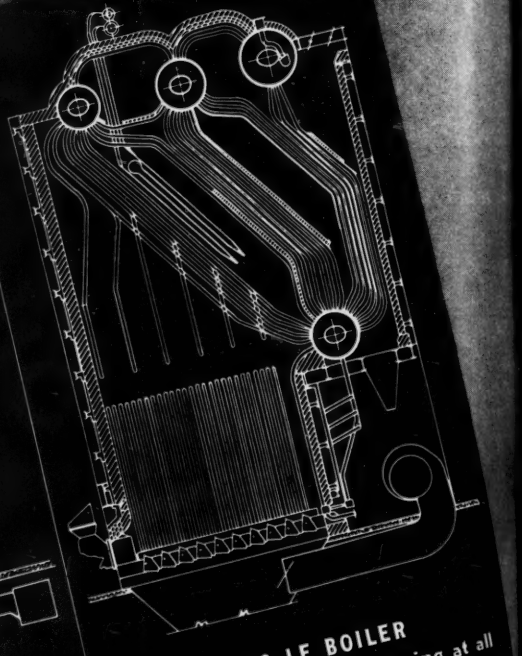
Y LTD., Windsor, Ontario

Vogt Steam



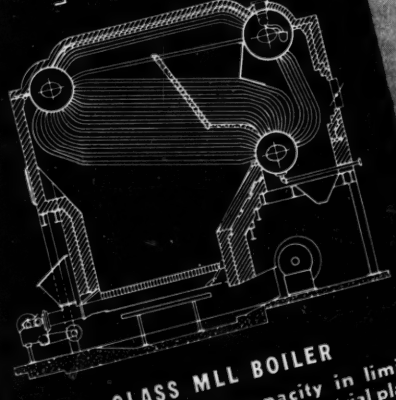
SECTIONAL HEADER BOILER

Sinuous forged steel headers feature this straight tube, cross-drum type generator. Staggered tubes achieve high heat transfer rate and insure efficient operation.



CLASS LE BOILER

Unsurpassed for quick steaming at all ratings, this four drum, bent tube type will carry high overloads with high efficiency.

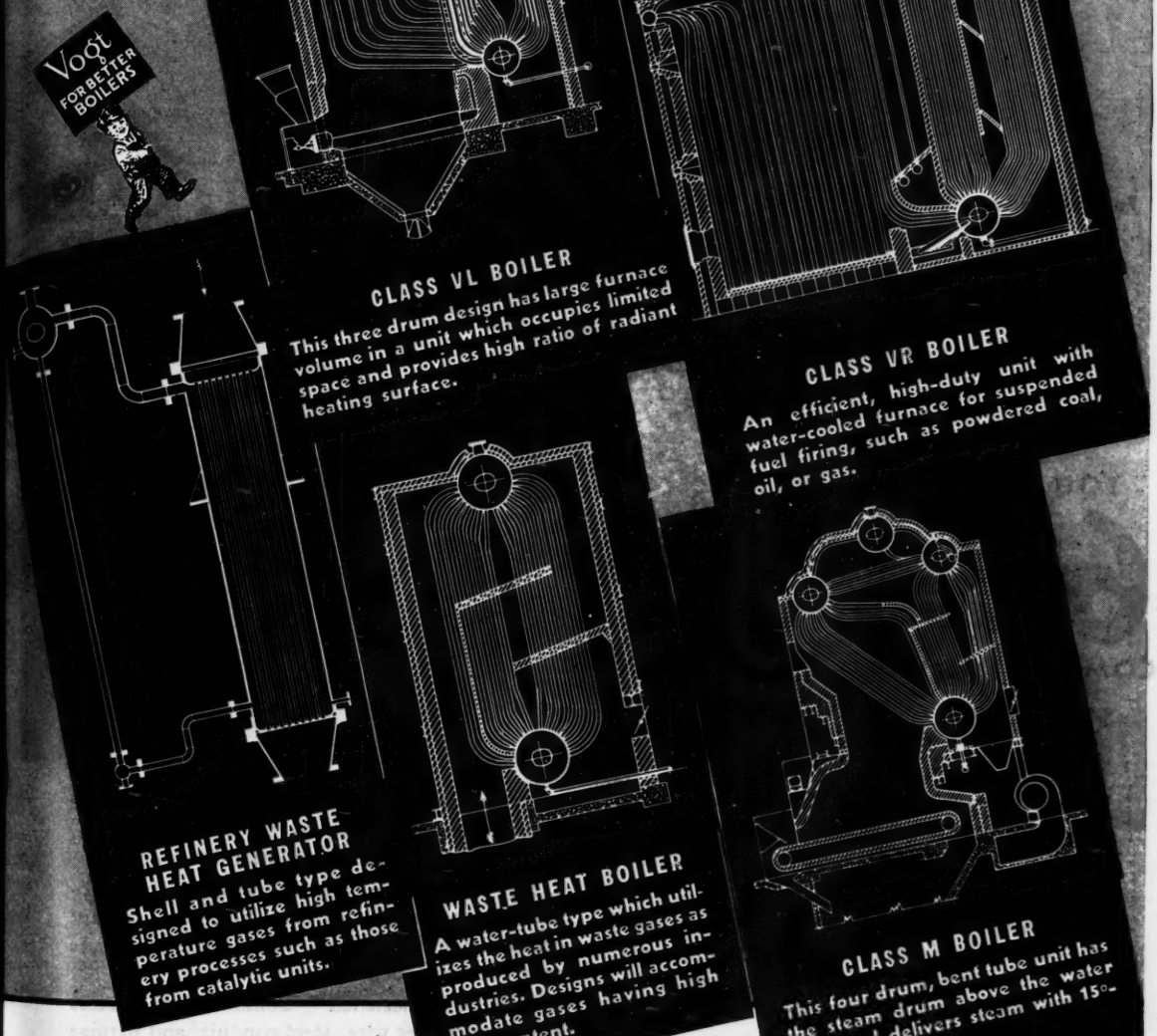


CLASS MLL BOILER

Provides maximum capacity in limited headroom. Widely used in industrial plants, institutions, etc., having moderate processing or power loads, and for heating.

HENRY VOGT MACHINE CO., Inc.

GENERATING UNITS



CLASS VL BOILER

This three drum design has large furnace volume in a unit which occupies limited space and provides high ratio of radiant heating surface.

CLASS VR BOILER

An efficient, high-duty unit with water-cooled furnace for suspended fuel firing, such as powdered coal, oil, or gas.

REFINERY WASTE HEAT GENERATOR

Shell and tube type designed to utilize high temperature gases from refinery processes such as those from catalytic units.

WASTE HEAT BOILER

A water-tube type which utilizes the heat in waste gases as produced by numerous industries. Designs will accommodate gases having high dust content.

CLASS M BOILER

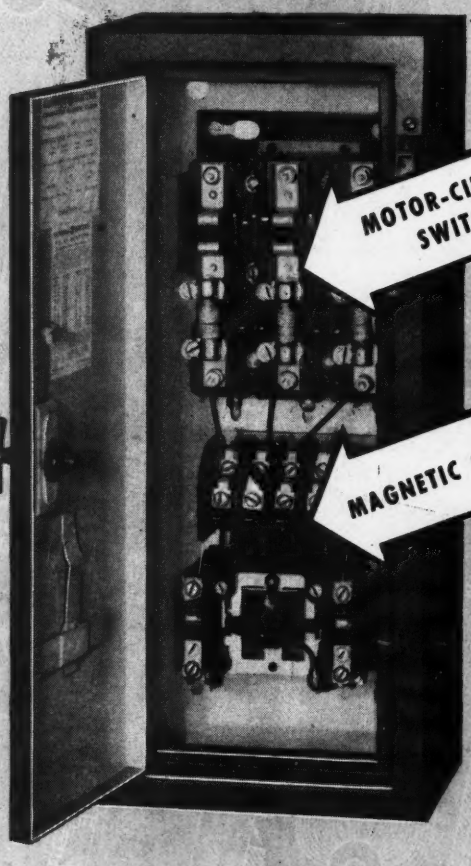
This four drum, bent tube unit has the steam drum above the water level and delivers steam with 150° superheat.

1000 WEST ORMSBY STREET
LOUISVILLE 10, KENTUCKY

BRANCH OFFICES: *New York • Chicago Cleveland • Philadelphia • Dallas*

MOTOR STARTERS EVERY TYPE,

DEPENDABLE . . . ATTRACTIVE IN APPEARANCE



For full-voltage starting of squirrel-cage a-c motors

BOTH IN ONE UNIT

YOU SAVE 6 WAYS WITH COMBINATION STARTERS

1. Save Ordering Time—Instead of buying two separately mounted devices, you buy one factory co-ordinated unit that controls and protects your motor.

2. Save Installation Time—Users report a 50 per-cent reduction in mounting time, a 40 per-cent reduction in wiring time, as compared with the installation of two separate devices. You connect only 9 terminals—not 15.

3. Save Man Power—By eliminating one complete mounting job on every installation, you save valuable man power.

4. Save Money—Cost slightly more than two separately mounted devices, but the difference is more than made up by the savings in wire, conduit, fittings, and installation-labor costs.

5. Save Wall Space—Take up less space than separately mounted devices. You can mount combination starters in small, unused spaces near the operators.

6. Save Critical Materials—Combination starters have less copper wire, steel conduit, and fittings than separately mounted devices

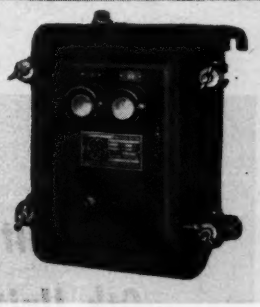
—and they save your motors, too. The fuses, or the breaker, are co-ordinated with the thermal overload relays to give complete motor protection under short-circuit or overload conditions.

EVERY KIND, FOR EVERY MACHINE APPLICATION

DESIGNED TO BLEND WITH MODERN MACHINES

Magnetic Full-voltage Starter—Designed to provide long life, ease of installation, readily accessible parts for quick inspection, and the dependability requisite to modern industrial needs.

Magnetic Full-voltage Starter—Showing Selector switch mounted in the cover of a general-purpose case.

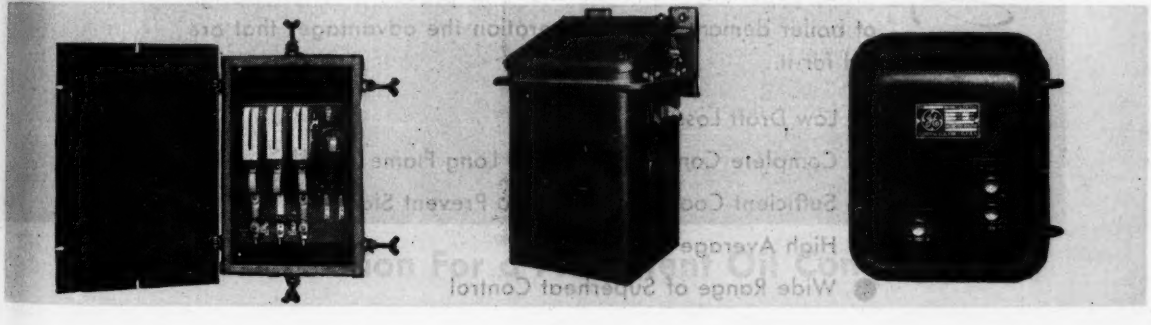


A-c Magnetic Starter with Watertight Case—Wall-mounted, overload-relay reset button in cover, and push button can be added.

Starter with Dust-tight Case—Fabricated, case of cold-rolled sheet steel—wall-mounted—overload-relay reset button in cover.

Oil-immersed General-purpose Starter—Suitable for use in corrosive atmospheres found in such places as chemical plants and oil refineries, or for outdoor use.

Starter for Hazardous Locations—Will withstand internal explosion—high tensile cast iron will meet hydrostatic pressure test—overload-relay reset button in cover.



NAME YOUR APPLICATION

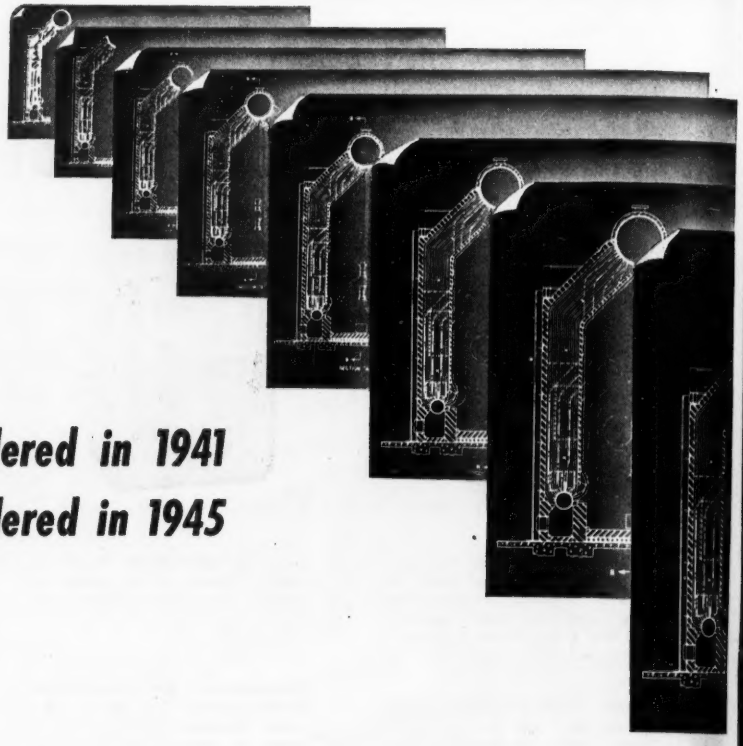
G-E starters come in a variety of enclosures to meet any operating condition, and are available for motors from 1 to 1000 horsepower. Write today for further information about these starters—our engineers will be glad to help you select the correct type for your needs. *General Electric Company, Schenectady 5, N. Y.*

INDUSTRIAL CONTROL

GENERAL ELECTRIC

BUY WAR BONDS

NINE "S.A." BOILERS FOR ONE



1st Unit Ordered in 1941
9th Unit Ordered in 1945

ACTUAL experience with the first unit proved that this design of boiler demonstrates in operation the advantages that are claimed for it.

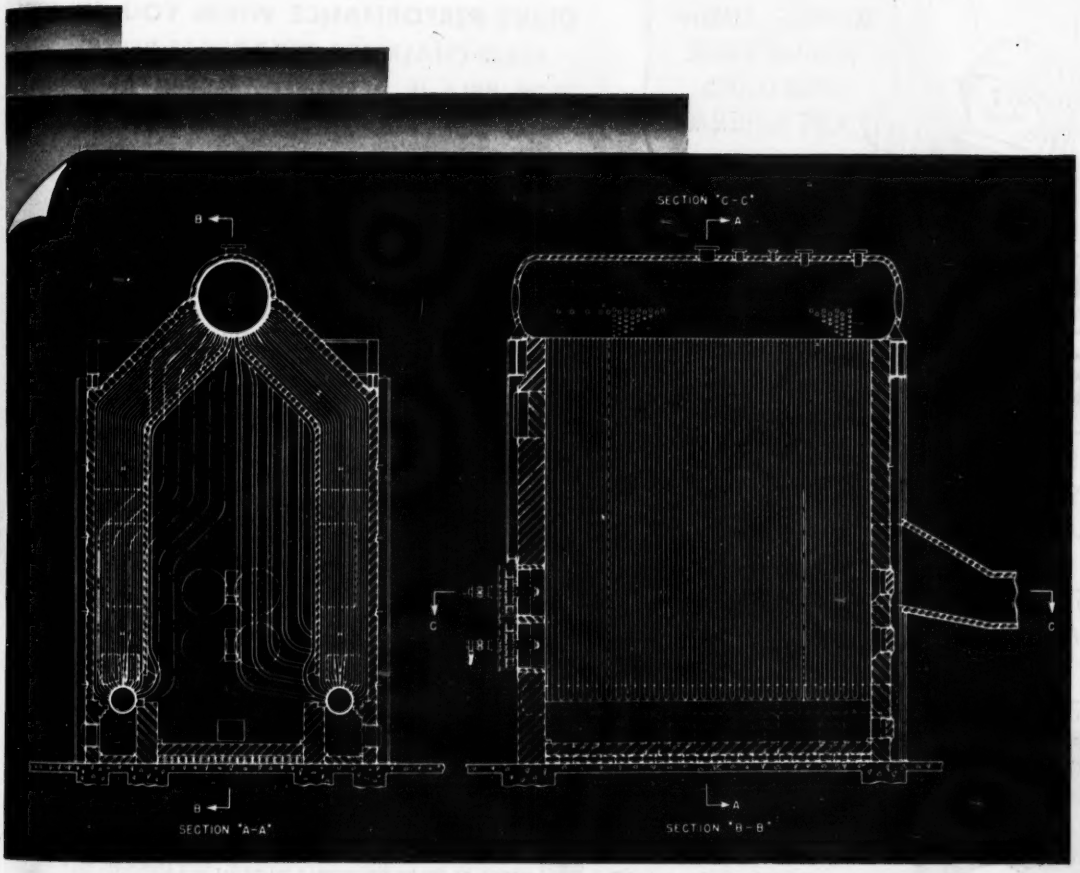
- Low Draft Loss
- Complete Combustion due to Long Flame Travel
- Sufficient Cooling of Gases to Prevent Slagging
- High Average Efficiency
- Wide Range of Superheat Control

Performance tells the story... there was no question as to what boiler to install when increased steam demands made additional steam capacity necessary.

FOSTER WHEELER CORPORATION
165 BROADWAY • NEW YORK 6, N. Y.

FW **FOSTER**

OIL REFINERY IN *FIVE* YEARS



Refinery Installation For a Prominent Oil Company

	Present Operation	*Contemplated Future Operation*
Number of Units	5	9
Steam Capacity	70,000 lb. per hr.	70,000 lb. per hr.
Design Pressure	645 lb. per sq. in.	645 lb. per sq. in.
Pressure: Superheater Outlet	250 lb. per sq. in.	600 lb. per sq. in.
Final Steam Temperature	(Saturated)	750 degrees F.
Feedwater Temperature	225 degrees F.	300 degrees F.
Fuel	Refinery Gas	Refinery Gas
Efficiency	79.1 per cent	83.0 per cent (with air heater)

WHEELER

Prepared for ACTION!

YOU'RE SURE TO GET TOP-FLIGHT DRIVE PERFORMANCE WHEN YOU SPECIFY ALLIS-CHALMERS TEXROPE V-BELTS . . . EACH BELT IS DESIGNED, TESTED AND BUILT TO SOLVE SPECIFIC DRIVE PROBLEMS

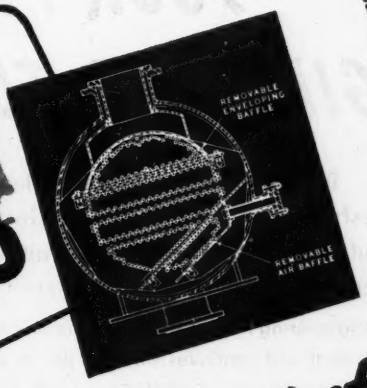
REALLY BAD OIL CONDITIONS ARE MY OBJECTIVES. I'M SUPER-7 OIL-PROOF...MADE OF SOLID NEOPRENE. GRIMY LIQUIDS DON'T BOTHER ME.
OIL
SUPER-7 STATIC-RESISTING TALKING: MY BUILT-IN CONDUCTING ELEMENT CARRIES STATIC CHARGES TO MACHINES WHERE THEY'RE GROUNDED.
HEAVY LOADS? EASY! MY STEEL CABLES ADD POWER, REDUCE STRETCH AND SLIPPAGE. I'M SUPER-7-STEEL.
90% OF ALL OIL CONDITIONS ARE A CINCH FOR ME. NEOPRENE IS MY COVER..SUPER-7 OIL-RESISTING, MY NAME.
HOT-RUNNING DRIVES ARE WHERE I SHINE. 180°F IS JUST COMFORTABLY WARM FOR SUPER-7 HEAT RESISTING. THAT'S ME.
A 1771

IT PAYS TO MAKE **ALLIS-CHALMERS** YOUR

V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

BAFFLES



. . . an important element of efficient STAGE HEATER design

ONE OF A SERIES OF ADVERTISEMENTS DESCRIBING THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

Look to the baffles if you want to make sure you will get most complete and efficient transfer of heat from steam to water as well as prevention of wear of tubes in the stage heaters you buy.

The baffle design and arrangement of G-R Stage Heaters are based on more than seventy-five years of experience in building closed water heaters. For example, the patented G-R enveloping steam baffle provides cross-over temperatures with superheated steam. This exclusive design not only permits heating the boiler feed water several degrees above the dry and saturated temperature of the extraction steam, but also is the only type of baffle that prevents the superheated steam from coming in contact with the heater shell, so as to prevent excessive expansion strains and possible warping.

The steam impact baffles, drain inlet baffles and air baffles, too, all have distinctive advantageous features in G-R Stage Heater designs. To learn about these exclusive benefits, write for our Bulletin 277 which describes in detail the various G-R designs for all pressures, temperatures, and plant requirements.

G-R BUILDS ALL THESE UNITS FOR HEAT TRANSFER SERVICE . . .

- Evaporators
- Stage Heaters
- Gas Coolers
- Drain Coolers
- Aftercoolers
- Air Preheaters
- Fuel Oil Heaters
- Jacket Water Coolers
- Process Heat Exchangers
- Transformer Oil Coolers
- Generator Air Coolers
- Lubricating Oil Coolers
- Storage Tank Oil Heaters

THE GRISCOM RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

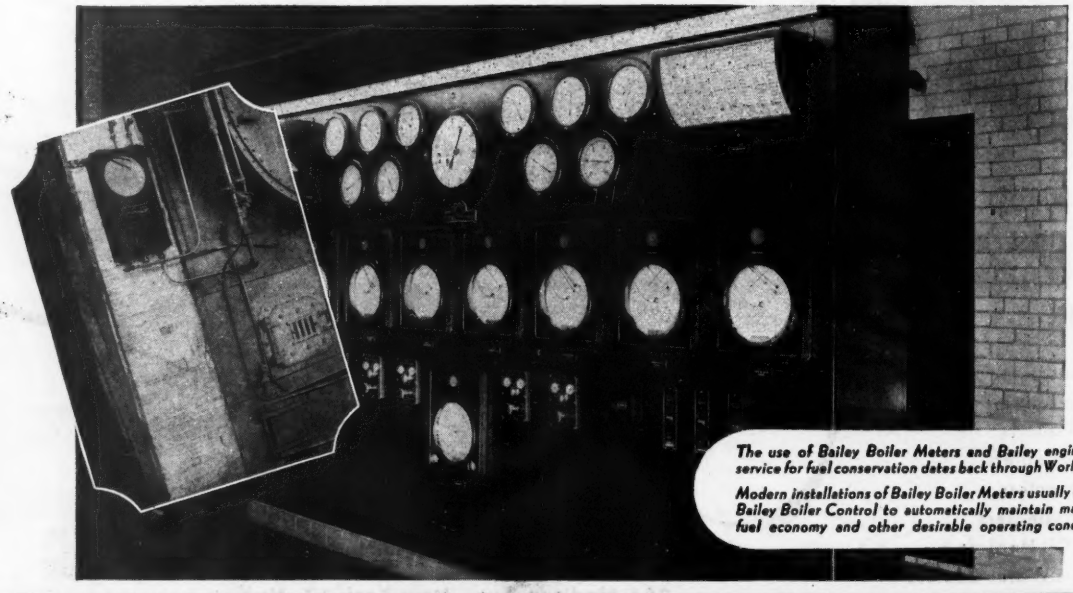
BAILEY BOILER METERS— YOUR PASSPORT to ENGINEERED FUEL CONSERVATION

Bailey Field Engineers backed by the know-how gained from thousands of successful Steam Flow—Air Flow installations adjust each Bailey Boiler Meter to the particular requirements of the unit which it serves. The meter then serves as a guide to firemen in obtaining maximum fuel conservation in everyday operation.

Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Much of this engineering work is done in the user's plant by Bailey Field Engineers who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has "know-how" at his command which was developed by over 25 years experience with the Steam Flow—Air Flow method of combustion control. This includes the records of tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that this engineer has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation and other benefits which result from the intelligent use of correctly selected and properly applied instrumentation. G-21A

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada



The use of Bailey Boiler Meters and Bailey engineering service for fuel conservation dates back through World War I.

Modern installations of Bailey Boiler Meters usually include Bailey Boiler Control to automatically maintain maximum fuel economy and other desirable operating conditions.

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

HOW TO *Simplify* STEAM TRAP INSTALLATIONS

Select the Body Style That Minimizes Fittings

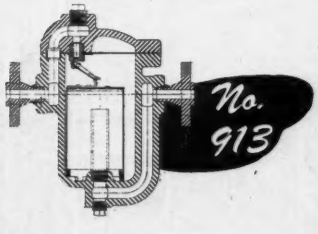
ARMSTRONG Inverted Bucket Steam Traps are available in either side-inlet side-outlet or bottom-inlet top-outlet body styles to provide the neatest possible hookups with a minimum of pipe fittings. There are five sizes of side inlet traps for pressures to 600 psi., capacities up to 4,000 lbs. of condensate per hour; nine sizes of bottom inlet traps for pressures to 2,400 psi., capacities to 20,000 lbs. of condensate per hour.

Valuable assistance on trap selection, installation and maintenance can be secured from the 36 page ARMSTRONG STEAM TRAP BOOK. Your copy available on request.

ARMSTRONG

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

New! **No. 913 cast steel side-inlet trap for pressures to 600 psi. or where all steel fittings are desired.**



• Trap may be opened for inspection or repair without disturbing pipe connections. Just remove the cap and mechanism as a unit. Stainless steel working parts. Screwed or flanged connections. Height 11¼".

3 CONDENSING PLANTS

Since October, 1939, three new generating units, built and designed by Stone & Webster Engineering Corporation, for a Southeastern utility have been placed in operation. The surface condensing plants for all three turbine-generators were built by Ingersoll-Rand.

FIRST CONDENSER INSTALLED AND TESTED

In recommending Ingersoll-Rand for the first new unit, the contracting engineers spoke with the confidence based upon the many hundreds of outstanding I-R condenser installations, not a few of which Stone & Webster had installed. Tests made on the first condenser, a single-pass divided type serving a 40,000-kw generator unit, showed that performance guarantees for all operating conditions were exceeded by a wide margin. Moreover, the station operating manager called attention to the fact that the I-R hotwell construction provided condensate almost entirely free of oxygen and reheated it to inlet temperatures.

Ingersoll-Rand equipment serving this condenser included a two-stage steam-jet air ejector, vertical propeller-type condensing water circulating pump and two hotwell condensate pumps.

SECOND CONDENSER INSTALLED AND TESTED

Several months after the initial installation was placed in operation, an additional 40,000-kw generating unit was ordered for another station. The tests of the initial plant had already been made and thoroughly studied, and the efficiencies that they demonstrated influenced the selection of Ingersoll-Rand equipment.

As before, steam-jet removal equipment, as well as condensate and circulating water pumps were supplied by Ingersoll-Rand.

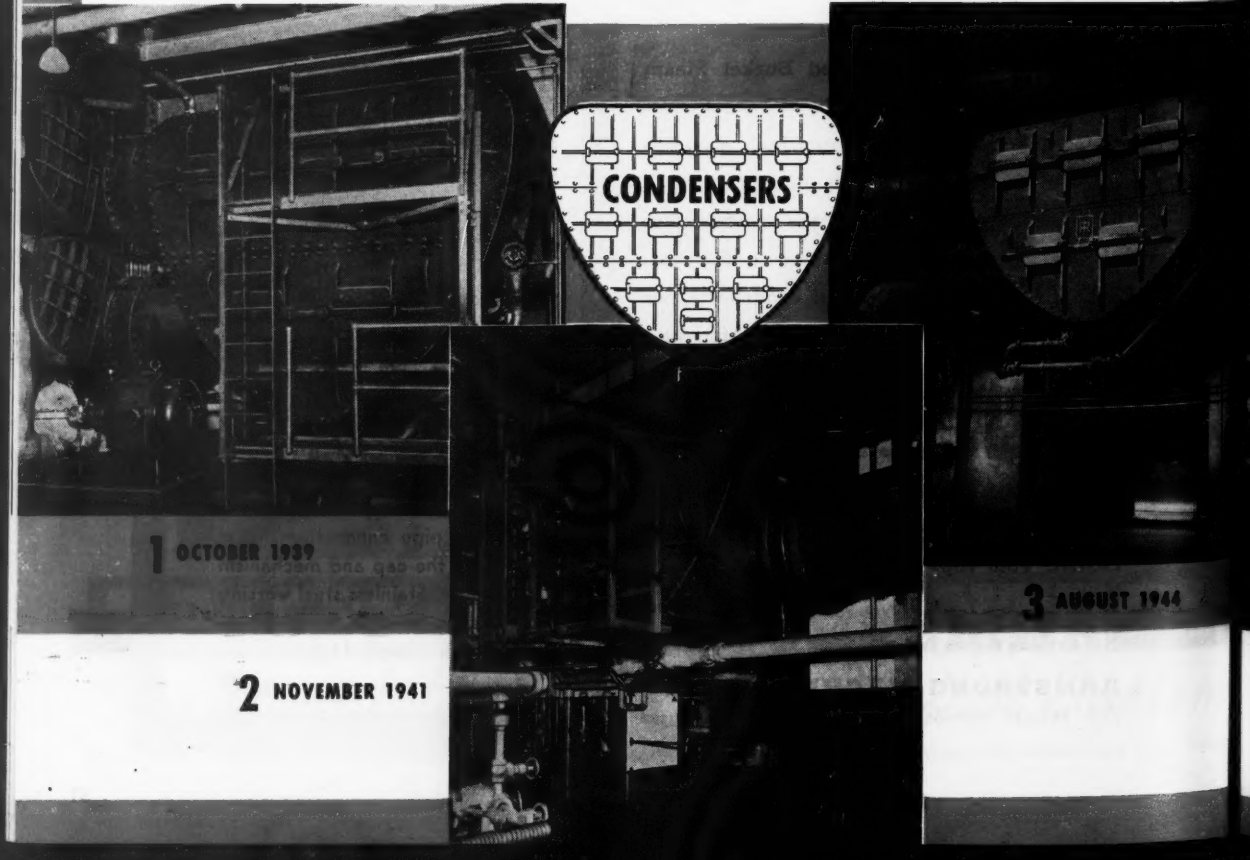
THIRD CONDENSER NOW OPERATING

In 1944, Stone & Webster completed a new plant for this same Company. One 50,000-kw turbine-generator was installed in this station, and it is served by an Ingersoll-Rand condensing plant.

This third order illustrates the confidence which both the Utility Company and Stone & Webster Engineering Corporation have in Ingersoll-Rand condensing equipment.

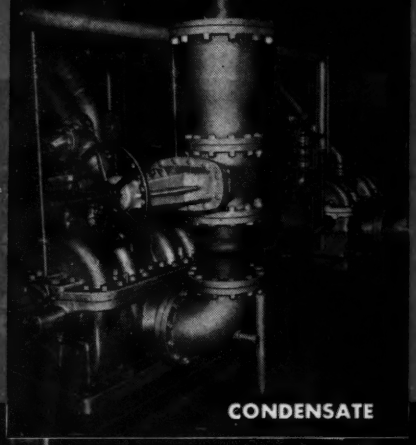
• • • •

Ingersoll-Rand's many years of original and progressive condenser design, the construction refinements that reduce maintenance to a minimum, and the results obtained in actual installations are sound recommendations for the selection of Ingersoll-Rand Condensing Plants.

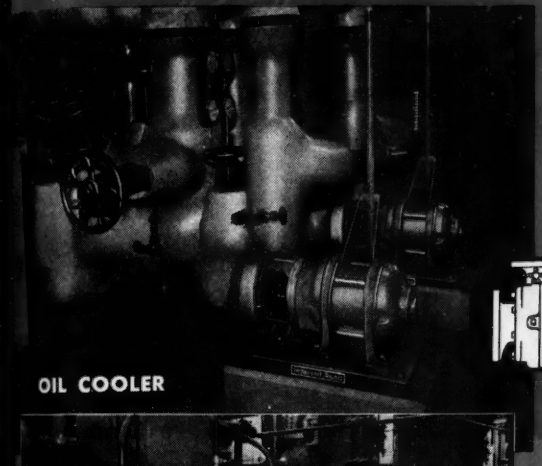


FOR 130,000 KW

Expansion Program of a Southeastern Utility

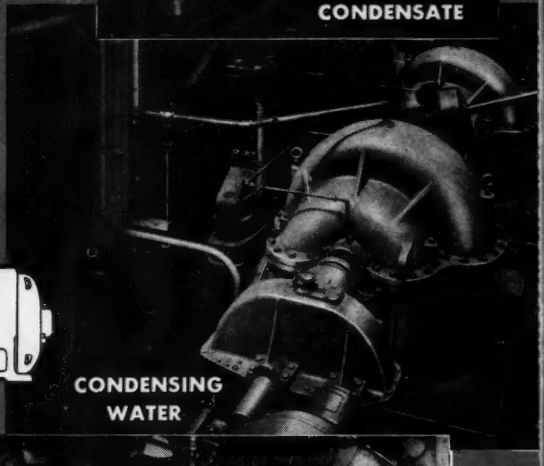


CONDENSATE



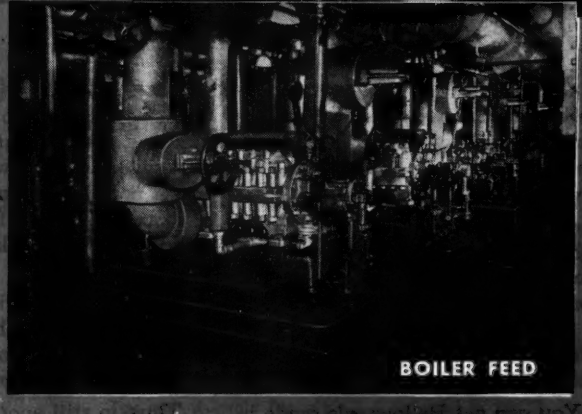
OIL COOLER

PUMPS

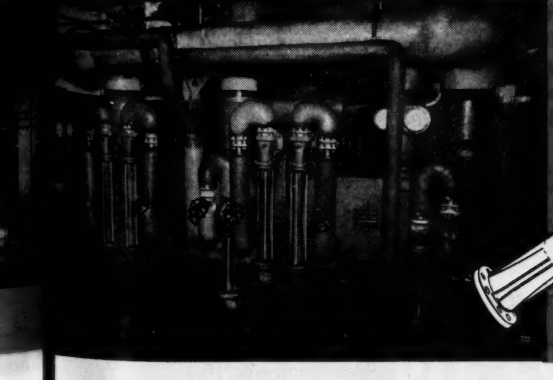


CONDENSING WATER

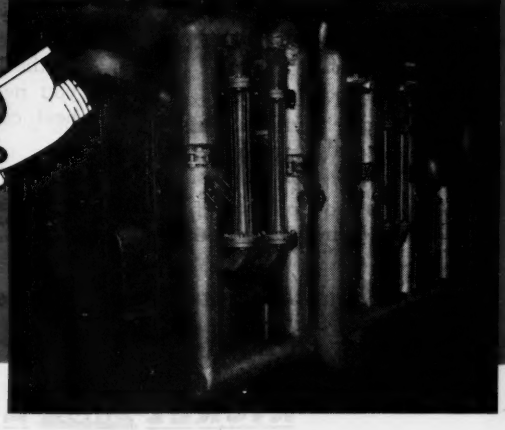
HOUSE SERVICE



BOILER FEED



AIR EJECTORS



Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

4-590

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

Here's a new way to lick leaking joints in high-pressure and high-temperature steam lines.

With Goetze Bellowseal Gaskets, line pressure itself maintains the tightness of the closure—*the higher the pressure, the tighter the joint.* For, as pressure rises, the two plates of the Bellowseal are forced apart into the packing to form perfectly leak proof joints.

You can get Bellowseals made in MONEL to meet all operating ranges and conditions. For high-temperature or corrosive service, MONEL is particularly suitable.

Use of MONEL cancels the threat of corrosion or oxidation which could make the seal inoperative through puncture or "freezing" of inside faces.

MONEL also supplies the full measure of high-temperature strength and resilience needed to withstand constant expansion and contraction. Moreover, its good welding qualities mean perfectly sound welded joints—thoroughly free from porosity—strong enough to take repeated flexing.

And from the viewpoint of the manufacturer (who has to groove the outer faces) the good machinability of MONEL is important, too.

Thus, in still *another* power plant application, MONEL is used as insurance for long life and trouble-free operation. Investigate MONEL and all the INCO Nickel Alloys whenever you need strong metals that fight heat, corrosion, wear and fatigue.

**As proved in tests using a 6" —400# A.S.A. Van Stone flange assembly with flange bolts only finger-tight. Gasket showed no leakage during cycle changes from 0 to 600 psi steam at temperatures from saturated to 850° F.*

The new GOETZE BELLOWSEAL GASKET

consists of 2 discs of 1/16" metal, serrated on one face and welded together around their outer periphery. When installing the Bellowseal, a ring of thin, compressed asbestos sheet packing is placed over the serrations. Then, the joint is tightened up with sufficient bolt force to cause the latter to penetrate the packing. After penetration, bolt stress can be reduced to an operating value considerably lower than that usually necessary for all-metal gaskets. The slight bevel of the inner edges of facing discs ensures penetration of the pressure *between* the discs and expansion of the gasket. Bellowseals are made by the Goetze Gasket and Packing Co., Inc., New Brunswick, N. J.

(The gasket above was tested beyond normal operating deflection to show the working principle of the new Bellowseal gasket.)

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N.Y.

NICKEL (INCO) ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings...Welding Rods (Gas & Electric)

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Reports of cleaner Diesels... fewer repairs... time after time...

mean that Nonpareil HD Diesel Oil has something worth looking into if your engines suffer from wartime fuels and heavier loads.

Service records on all types of engines, under every conceivable operating condition—mostly the harder jobs of lubrication and those aggravated by wartime fuels and heavy loads—show that Nonpareil HD has brought cleaner operation in many instances where all previous oils have failed. Just a few examples are briefly described here. Ask the Standard Oil Representative who calls on you where you can see a plant, and talk to the operator who has had similar results from Nonpareil HD.

Nonpareil HD is not only a detergent and oxidation-inhibited oil, but it is outstanding among the few truly heavy-duty oils available for industrial Diesel service. The booklet illustrated here tells why. Send for a copy. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

In a municipal light plant, operating a 750 hp. Fulton engine, there was an immediate improvement in the appearance of cylinder walls after only 370 hrs. of operation on Nonpareil HD Diesel Oil. In addition, only about 1 pound of solids was taken from the centrifuge each 15 hours, whereas 3 to 5 pounds accumulated with previous oils.

The operator of a Model 33 F-M Diesel comments, "Since using Nonpareil HD Diesel Oil, my engine rolls to a stop and rocks slightly, instead of coming to a dead solid stop." A sure sign of less friction and better lubrication afforded by Nonpareil HD!

Two old, 4-cycle Diesels were operated in the power plant of a mid-western cement mill. Because of severe operating conditions and the extreme age of the equipment, ring replacements, and blow-by—which resulted in bearing failure—made down-time and operating time about equal on these engines. It was necessary to pull pistons and break rings loose every 60 to 90 days. In over a year, on Nonpareil HD, the pistons have not even been pulled and no bearings replaced.

Buy more War Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

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LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

It was easy to pick the right grease then...

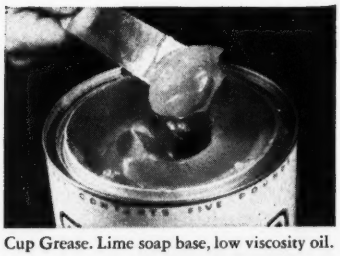
When greasing a wagon or mill wheel was the only lubrication problem, and the principal choice of lubricant lay between bacon rind and axle grease, everyone was his own lubrication specialist. The oak or maple bearings on the old mill wheels could be replaced every winter, if needed. If the grease on wagon wheels became too stiff in cold weather, the horses pulled harder. But horsepower today is more temperamental.

Many factors now enter into the selection of grease: such as types of bearings, bearing clearances, pressures or loads, temperatures, speeds, and the many possible combinations of these. To meet these conditions, there are numerous types and grades of grease, with various oil viscosities, penetration characteristics, and temperature- and water-resistant qualities.

Fitting these many types of grease to the countless jobs requiring grease lubrication in industry is a specialist's work. Standard Oil has such specialists. The Lubrication Engineer in your locality will help you with this problem. He has a wide range of products from which to choose. He's had years of practical experience in applying them.

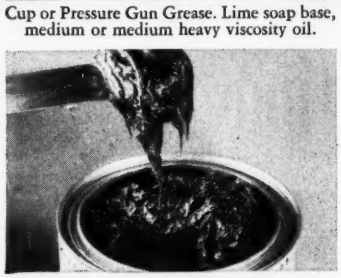
Why not put your grease lubrication in the hands of the Standard Oil Lubrication Engineer near you? Let him help you start saving horsepower and maintenance *now* for the coming competitive post-war period.

Buy more War Bonds

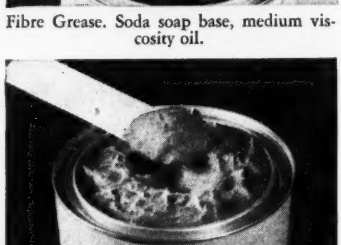


Cup Grease. Lime soap base, low viscosity oil.

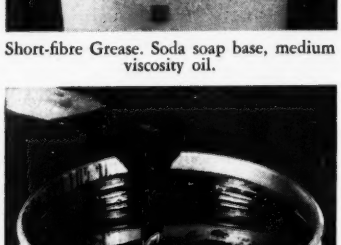
Cup or Pressure Gun Grease. Lime soap base, medium or medium heavy viscosity oil.



Fibre Grease. Soda soap base, medium viscosity oil.



Short-fibre Grease. Soda soap base, medium viscosity oil.



Compound. Usually no soap base, special petroleum stocks.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

★ LUBRICATION ENGINEERING

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make PACKING Last Longer . . .

The *kind* of packing and *how* you use it have a lot to do with maintaining peak pumping efficiency. Here, at left, is a step-by-step outline of the correct way to install pump packing — saving you vital man-hours and money as well.

MOST PACKING TROUBLE traces back to *lack of "know-how"* in caring for stuffing boxes. This is wasteful — time and money-wise — especially since *correct* packing procedure is so simple for maintenance men to understand and practise.

Another class of trouble traces to misalignment of pump and motor. For when shaft is deflected, sleeve is apt to wobble — greatly accelerating packing wear. To eliminate this problem, A-C engineers developed, for many applications, the "Electrifugal" pump — in which both motor and impeller are mounted on *one* shaft, in *one* frame. This means fewer parts, fewer bolted connections — no chance for misalignment.

Regardless of type of pumps you use, here is an outline of correct packing procedure — plus a few tips on what to look for when trouble *does* arise . . .

▸Make certain packing is suitable for service it must perform . . . that it's the right size and made of the right materials. Be cautious of so-called "all-purpose" packings. If in doubt, check with your pump manufacturer.

▸Don't force in new packing against the old. It's apt to displace lantern ring and plug sealing liquid opening. First remove *all* old packing; clean stuffing box thoroughly; then insert new packing.

▸Put each ring of packing in separately, seating it firmly before adding the next. Stagger adjacent rings so that joints are at 180° angle to each other. If lantern rings are used, be careful that sealing liquid openings aren't blocked as new rings are installed.

▸After required number of rings have been inserted, tighten gland nuts. Gland should be taken up evenly to *finger-tightness*. If compressed too tightly, packing will burn out or sleeves become scored.

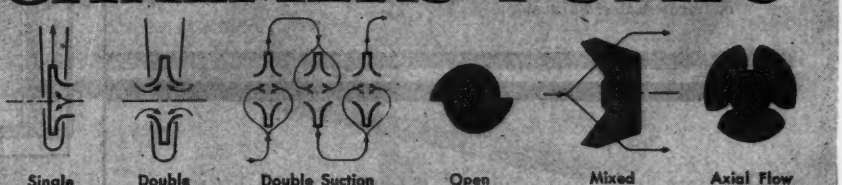
▸Finally, until shaft turns over freely, operate pump for about 1-minute intervals — permitting packing to cool. Then put it into continuous operation.

▸What to check for if packing wears too quickly — (1) Check shaft sleeves. If badly scored they grind down packing rapidly; (2) Check position of lantern ring. It may be displaced; (3) If water seal piping is used, check liquid. If it contains grit a separate source of sealing liquid should be obtained.

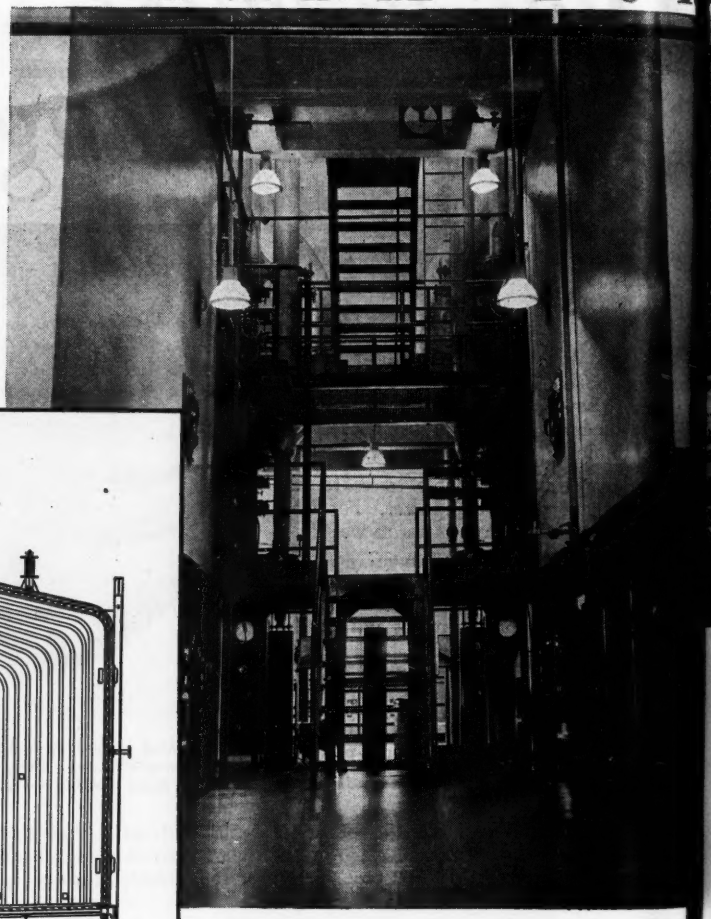
▸Send for your *free* copy of Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps". It's the basic, easy-to-understand guide to efficient centrifugal pump maintenance. Contains *no* advertising; applies to *all* makes. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1754

ALLIS-CHALMERS PUMPS

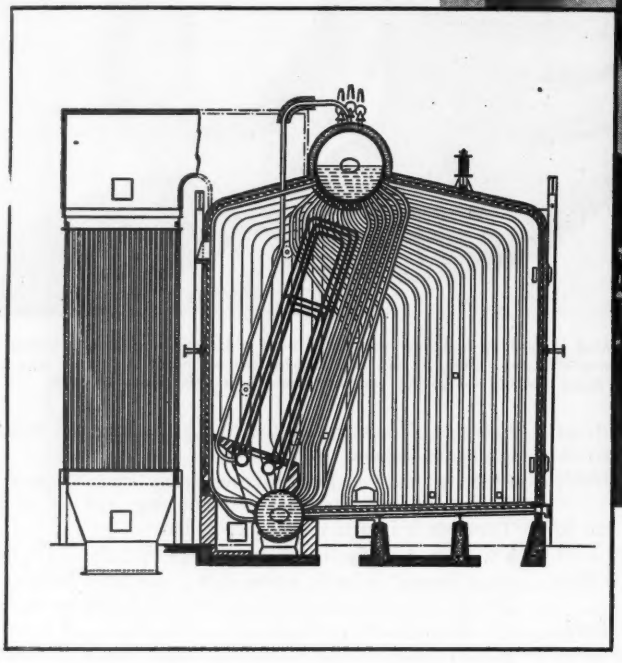
Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



STEAM FOR

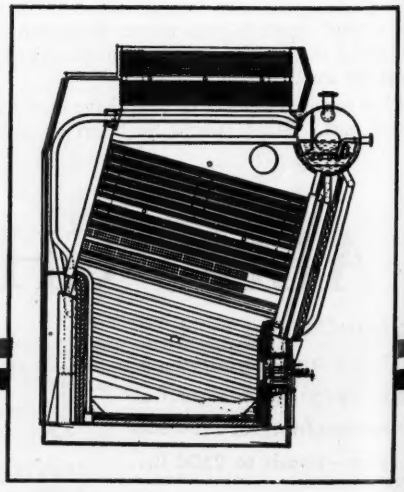


Installation of B&W Integral Furnace Boilers at Fontana Steel Plant.

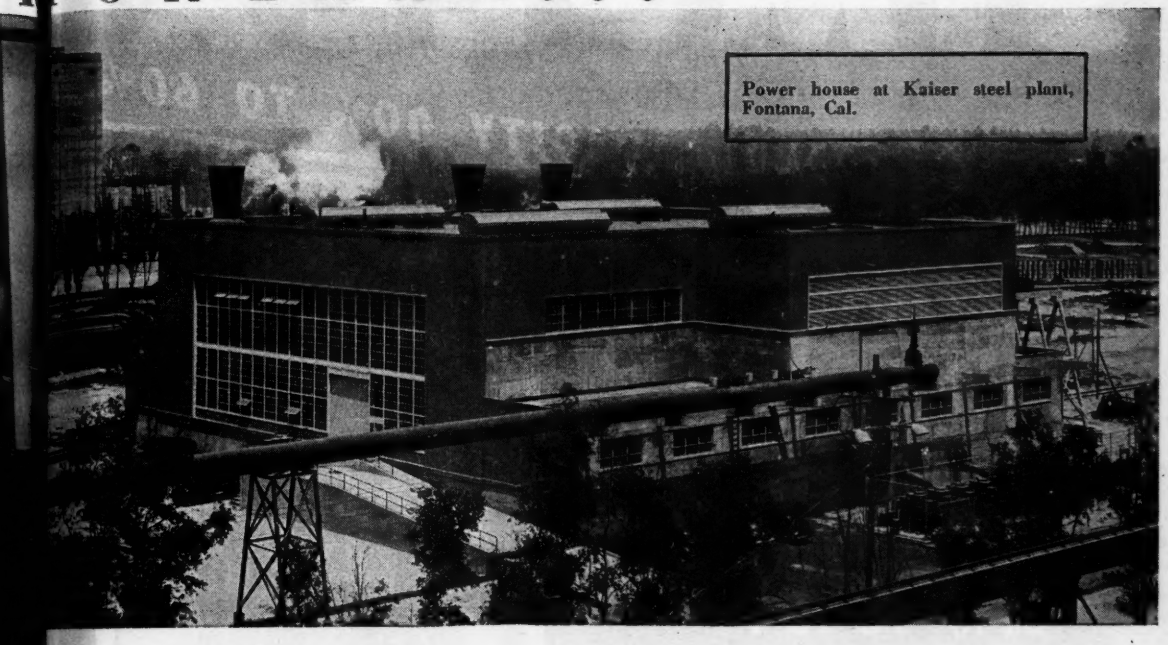


AT KAISER COMPANY STEEL PLANT—B&W Integral-Furnace Boiler—capacity 160,000 lb. steam per hr. Two units of this size and one of 105,000 lb. capacity supply superheated steam at 475 psi, 700—750 F.

. . . ON KAISER-BUILT SHIPS . . .
B&W Single-Pass, Header-Type Marine Boiler—a design used on many Kaiser-built ships.



FONTANA...



Power house at Kaiser steel plant, Fontana, Cal.

...another job for B&W Integral Furnace Boilers

At the Kaiser Company's Fontana steel plant . . . where steel plate is produced for Kaiser-built ships . . . B&W Boilers provide all steam requirements for coke plant turbines and by-product processes, blast furnace turbo-blowers, and other mill services.

Speeding steel plate production for ship-building demands a steam supply of highest dependability . . . and the Fontana furnaces and ovens are getting it—economically—from three B&W Integral Furnace Boilers. These boilers are equipped with multi-fuel burners, enabling them to burn blast-furnace gas, coke-oven gas or oil, with provision for pulverized coal firing. Also at this plant, two B&W Gas-Tube Boilers are putting "waste heat" to work, producing low-cost by-product steam for open hearth operations.

This modern plant joins a long list of steel mills, chemical plants, refineries, ordnance and aircraft plants in which B&W Boilers have proved dependable in war production as in pre-war services.

Behind the application of these and other B&W Boilers is more than 60 years of experience which B&W engineers are always glad to share with power engineers.

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK 6, N.Y.

G-303T

SIMPLEX

INCREASE FLOW CAPACITY 40% TO 60%

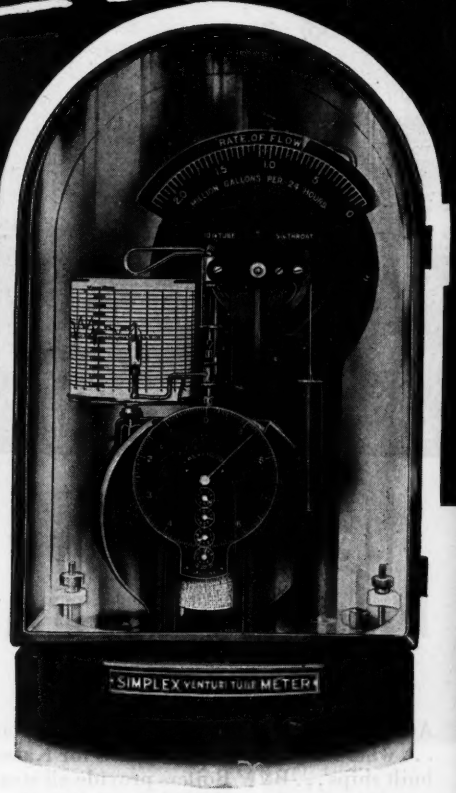
MOL or MOLA METERS

with flow ranges

FROM **20 to 1**

TO **28½ to 1**

OR TO **40 to 1**



Two typical examples of the ease and economy of increasing the maximum capacity of flow lines with the use of Simplex MOL and MOLA wide-range meters are given below:

1. **A change in operating heads enabled a large municipal water department to increase the total capacity of one of their pumps from a maximum of 60 million gallons per day to 72 million gallons per day by replacing the existing Simplex MO Meter with a Simplex MOL Meter. No change in the Venturi Tube, Pump Impeller, or motor was required, and operating costs showed a marked decrease.**

2. **By substituting an MOLA Meter for an MO Meter, increased requirements were met without any change in the Venturi tube, permitting an increase of from 13 million gallons per day to 21 million gallons per day.**

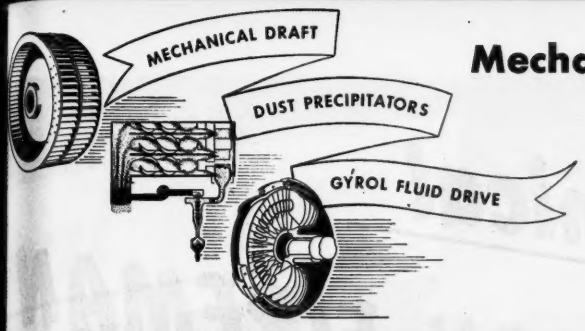
Simplex MOL and MOLA meters are designed to function over extremely wide flow ranges—and the accuracy of measurement and totalization is maintained at both maximum and minimum ends of the range.

Look into the advantages and economies of making use of Simplex instruments for performing the extraordinary as well as the conventional metering operation.

Write today; our recommendations are made without obligation.

SIMPLEX VALVE & METER COMPANY

6783 UPLAND STREET, PHILADELPHIA 42, PA.

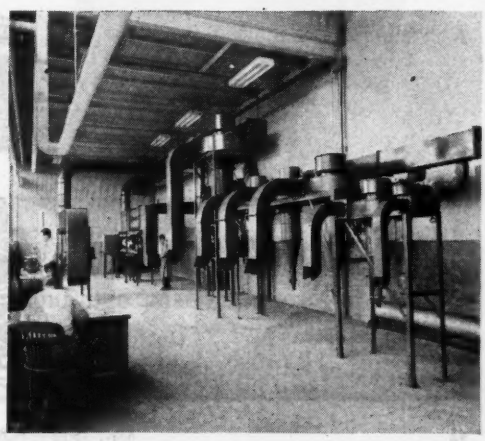


Mechanical Draft, Dust Precipitators, Fluid Drives—

BUY ALL THREE FROM A.B.C.!

Whether you are planning a fine new power plant for the postwar era, or are going to modernize your present plant, you can benefit by buying all 3 from A.B.C.! One source of technical information, far less red tape and, above all, undivided responsibility are yours when you select American Blower Mechanical Draft Fans, Dust Precipitators and Gyrol Fluid Drives for your plant. Phone or write the nearest American Blower Branch Office today.

HERE IS A PART of our complete Dust Testing Laboratories. Equipment is readily available to run every conceivable type of dust test. In the last 20 years, more than 4,100 distinctly different materials have been tested in these laboratories and results carefully filed in our "Library of Dust." If you have a fly ash problem, send your samples to us. We'll run tests, determine the best equipment suited to your individual needs. Remember, every Dust Precipitator and Dust Collector we sell is built entirely in our own plants, and designed to meet the requirements of the individual job it is to do. Your inquiries are invited. There is no obligation.



AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation.

Vick Chemical converts to IRON FIREMAN

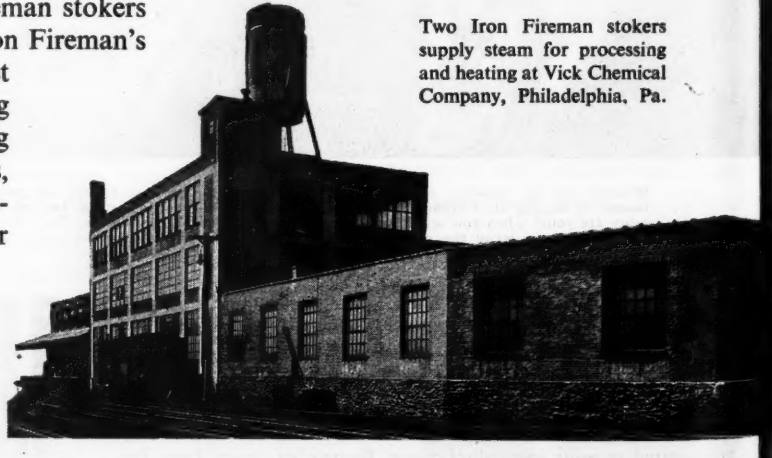
Averts Threatened Fuel Shortage

THE executives of the Philadelphia plant of Vick Chemical Company decided that conversion to coal was necessary to insure continuous operation. Steam is required for processing, heating water, air conditioning, humidifying and heating the building.

Iron Fireman automatic coal stokers were installed in August, 1942. Record cold weather this past winter made the heating load larger than usual, and steam requirements for manufacturing were greater than ever before. In spite of these increases, Iron Fireman stokers handled the load. In addition, Iron Fireman's automatically controlled firing met the problem of rapidly changing steam requirements for cooking raw materials. It has cut fuel costs, thus reducing coal tonnage, transportation, and thereby aiding our war program.

Easy to Change to Iron Fireman Coal Firing

If you are faced with fuel changes or increased steam loads, find out how quickly Iron Fireman equipment can be installed. Iron Fireman engineers are ready to make an immediate survey of your steam plant. No obligation. Iron Fireman Manufacturing Company, Portland, Oregon; Cleveland, Ohio; Toronto, Canada.



Two Iron Fireman stokers supply steam for processing and heating at Vick Chemical Company, Philadelphia, Pa.

IRON FIREMAN

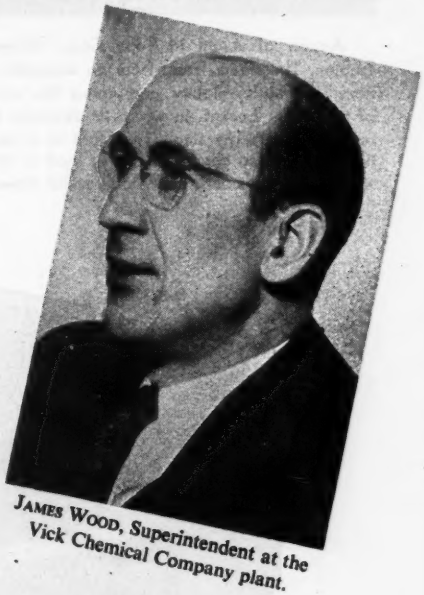
THE IRON FIREMAN

Automatic Coal Stokers

Sufficient space was not available at the front of the boiler and the Iron Fireman stoker was installed through the side of the furnace.

"Our Iron Fireman automatically controlled coal stokers now handle a rapidly fluctuating load that is even larger than the demand which was carried by our former firing system."

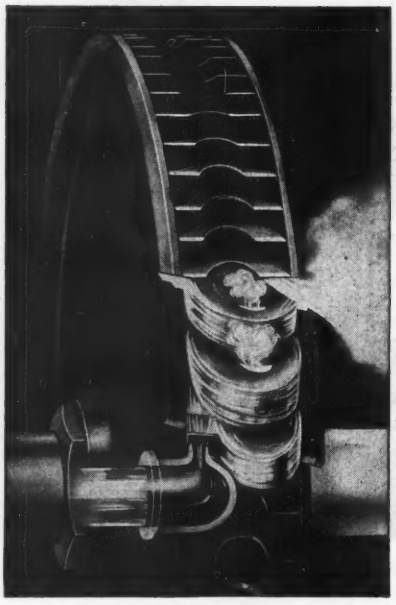
JAMES WOOD
Superintendent
Vick Chemical Co.



JAMES WOOD, Superintendent at the Vick Chemical Company plant.

IRON FIREMAN STOKERS ARE AVAILABLE—*Write for Information*
Output of Iron Fireman commercial and industrial stokers has been substantially increased to equip heating and power plants converting from oil, hand-fired coal and gas. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Mfg. Company, 3848 West 106th Street, Cleveland 11, Ohio.

The TERRY



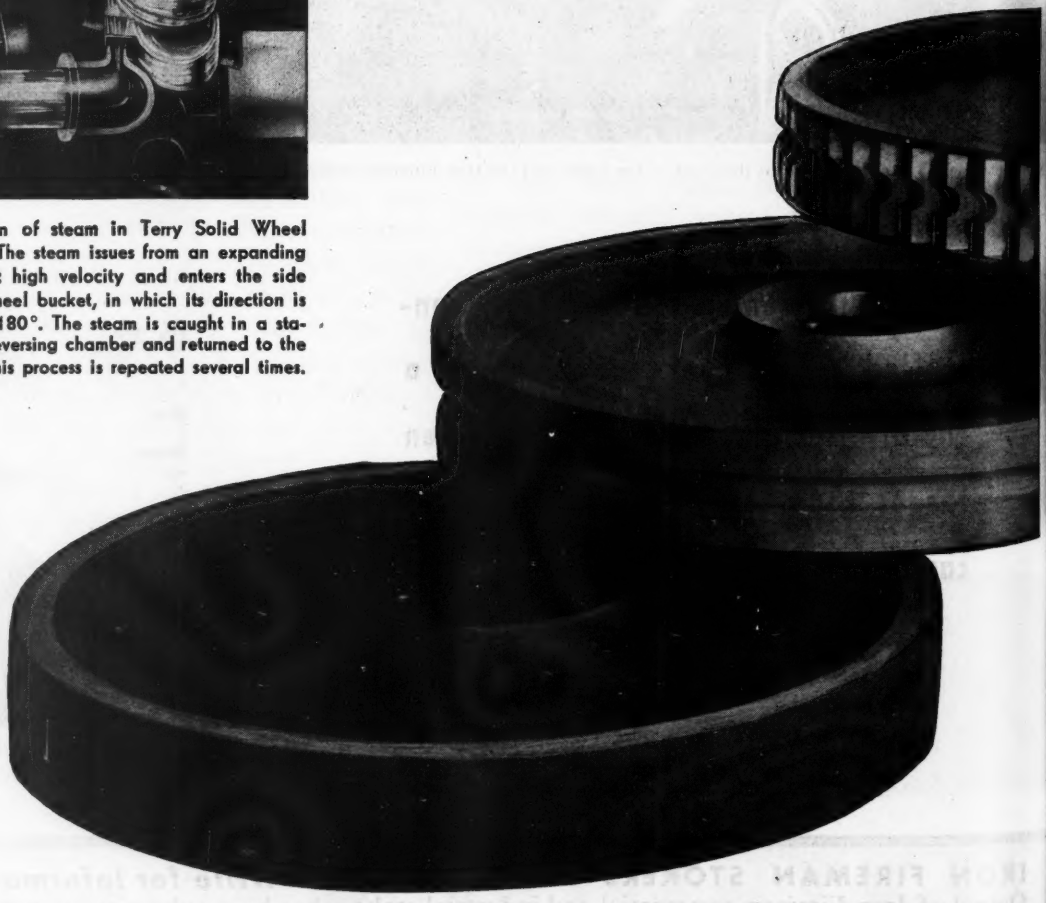
Action of steam in Terry Solid Wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket, in which its direction is reversed 180°. The steam is caught in a stationary reversing chamber and returned to the wheel. This process is repeated several times.

USES A SOLID STEEL ROTOR

The rotor of the Terry Wheel Turbine is made from a single forging of special composition steel. The semi-circular buckets or pockets are milled from the solid metal. The steps in the machining of a wheel are shown below. There are no parts to become loose or work out.

The power-producing action of the steam in the wheel buckets takes place entirely on the curved surface at the back of the bucket and therefore close blade clearance is not necessary.

As the only function of these blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horse power or efficiency. The important part of the bucket is the back or bottom, which is a solid forging.



FORGING — ROUGH TURNED

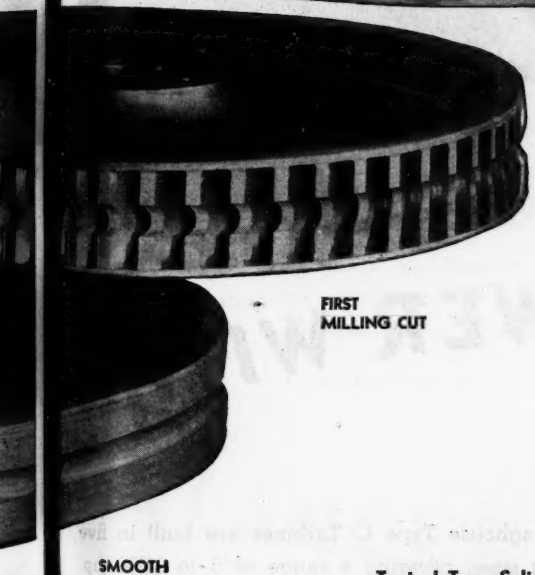
THE TERRY STEAM TURBINE CO.

Wheel Turbine

FINISHED WHEEL

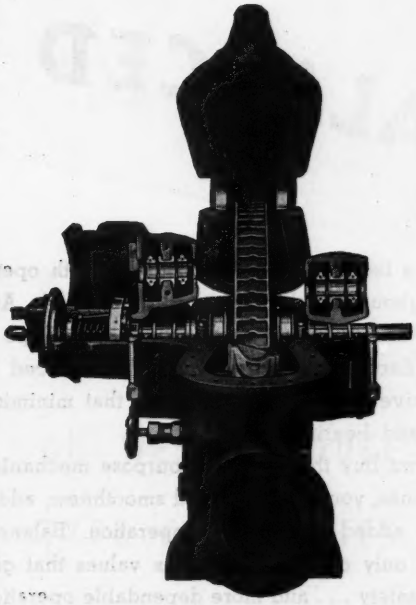
SECOND MILLING CUT

STEPS IN THE MACHINING OF A TERRY TURBINE WHEEL



FIRST MILLING CUT

SMOOTH TURNED



Typical Terry Solid Wheel Turbine with cover and bearing caps raised. Note the ruggedness and the accessibility of all parts. Units of this type are used to drive boiler feed pumps, generators, and all types of power plant equipment. Built in sizes from 5 H.P. to 2000 H.P.

FOR FULL DETAILS ASK FOR BULLETIN S-116

T-1156

TERRY SQUARE - HARTFORD, CONN.

BALANCED POWER WITH

It takes a balanced rotor to insure smooth operation throughout the full range of turbine speeds. And that's the kind you get in Westinghouse Type C Turbines. Each rotor is *dynamically* balanced by an *exclusive* Westinghouse process that minimizes vibration and bearing wear.

When you buy these general-purpose mechanical drive turbines, you get this added smoothness, added reliability, added economy in operation. Balanced rotors are only one of many plus values that give you extra safety . . . and more dependable operation.

Westinghouse Type C Turbines are built in five different sizes, covering a range of 5 to 1500 hp. The long list of proved-in-service installations includes pumps, forced and induced draft fans, pulverizers, compressors, Jordans, pulp beaters, line shafts, generators—and many other applications where steam drives are used to improve over-all heat balance.

For complete information call your nearest Westinghouse representative. Westinghouse Electric & Mfg. Co., Box 868, Pittsburgh 30, Pa. J-50458

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

The Dynetric balancing machine on which these turbine rotors are balanced is an exclusive Westinghouse development. It operates electronically to give positive indications of unbalance vibrations.

BALANCED ROTORS

ON WESTINGHOUSE TYPE C TURBINES

Every Westinghouse Type C Turbine Rotor is statically and dynamically balanced before assembly. Then, to insure preservation of the original perfect balance, a heavy coating of corrosion-resistant paint is applied to the rotor disc.

Elimination of unbalance vibrations is important to you. It means longer bearing life, smoother, quieter operation and fewer shut-downs for repairs. No power is wasted in destructive vibrations—it all goes to provide full power and efficiency.

Steam Headquarters

WESTINGHOUSE

The boiler operators were willing to learn

A small paper mill replaced several old hand-fired boilers with a new 145 psi. boiler, operated at 250% rating continuously.

Trouble started within two months, partly because the salesman of water softening equipment advised that no after-treatment of phosphate was necessary. Considerable carryover was experienced during the whole period, then tubes in the front water wall burned out.

A check revealed that the operators of the old plant, who were still on the job, had made little effort to maintain proper boiler water conditions. No one had tried to show them how.

Hall engineers were given a free hand to teach the personnel or to recommend changes if they seemed necessary to make sure that proper conditions were maintained. They chose the former course, and a Hall engineer practically lived at the plant for the next few weeks. Patiently he taught the "oldtimers" why water-conditioning was necessary, showed them what to do and how to do it, made them proud of their job. They cooperated loyally.

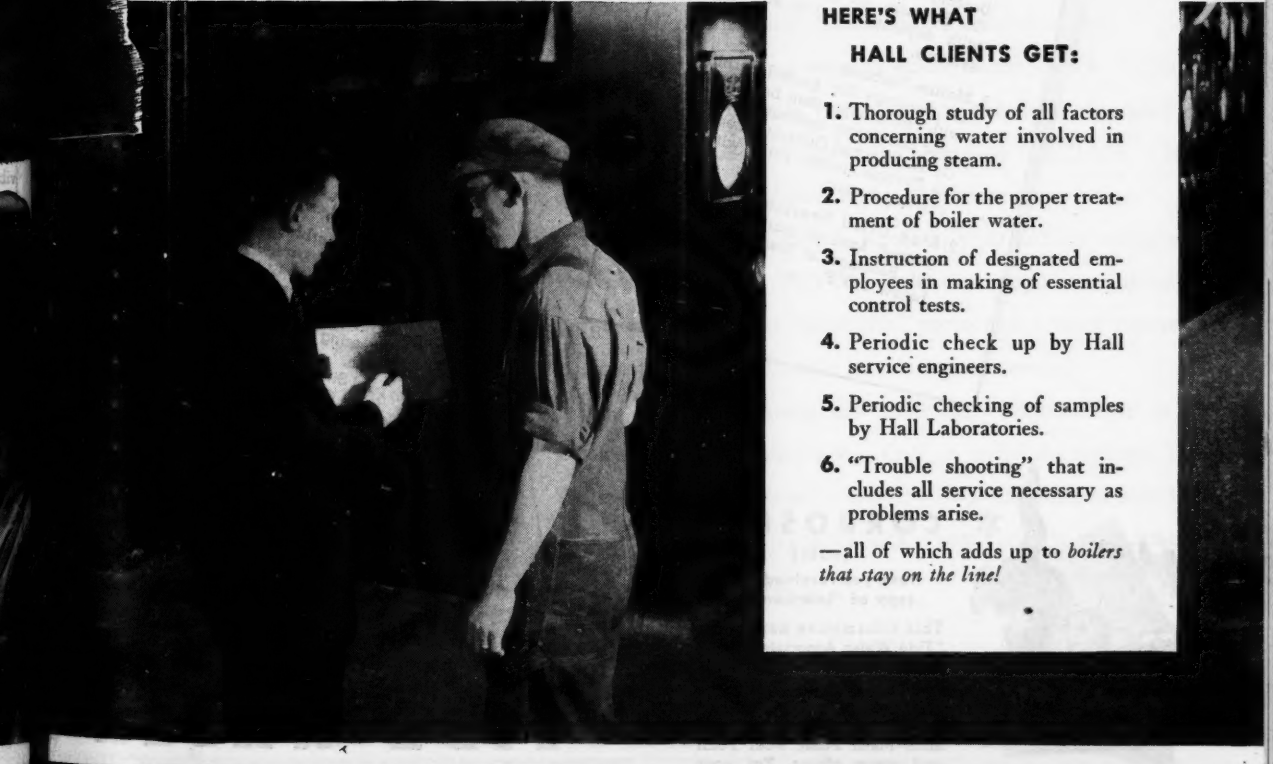
The result shows up in the report of a Hall service engineer, more than a year later, "No evidence of corrosion or hard scale formation. Fair amount of sludge in rear section, but washed out easily. Boiler has not been cleaned for one year, but superintendent stated that present condition was comparable to that of year ago."

This is just one more example of the fact that Hall service and Hall responsibility go far beyond prescribing chemicals to be added to the boiler water. Small plants as well as large need help and it is the job of the Hall service engineer to provide the right kind of assistance to maintain peak boiler performance.

Every plant that generates its own steam power can profitably use Hall service. Write us for full information.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
CALGON



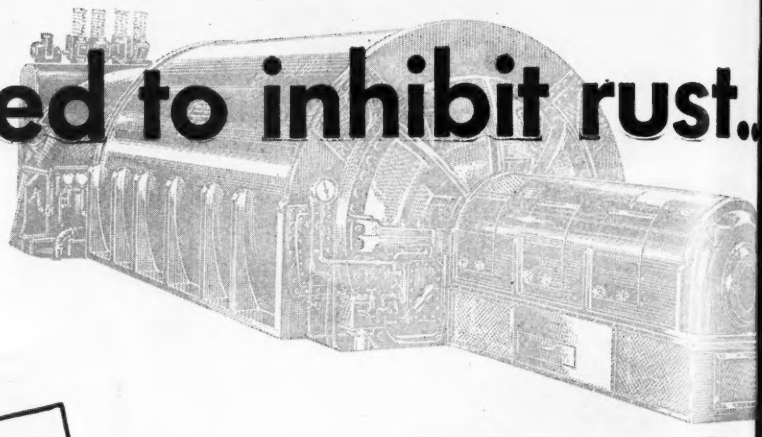
HERE'S WHAT HALL CLIENTS GET:

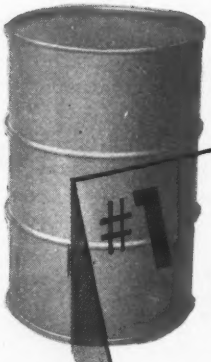
1. Thorough study of all factors concerning water involved in producing steam.
2. Procedure for the proper treatment of boiler water.
3. Instruction of designated employees in making of essential control tests.
4. Periodic check up by Hall service engineers.
5. Periodic checking of samples by Hall Laboratories.
6. "Trouble shooting" that includes all service necessary as problems arise.

—all of which adds up to *boilers that stay on the line!*

ALL SYSTEM *of Boiler Water Conditioning*

Engineered to inhibit rust...





#1

TYCOL RIO TURBINE LIGHT

Engineered and recommended for:

1. **Stationary Turbines**
   (a) Bearings on direct connected bearing circulating systems.
   (b) Bearings on geared turbines with separate bearing and gear systems.
2. **Marine Turbines**
   (a) Bearings on geared turbines with two independent bearing and gear circulating systems.
   (b) Turbine and Generator bearings on Turbine-electric Drive with circulating system.
3. **Ring Oiled Bearings (Direct or geared, land or marine)**
   (a) Bearings at low temperature, below 140°F.

#2

TYCOL RIO TURBINE MEDIUM

Engineered and recommended for:

1. **Stationary Turbines**
   (a) Geared turbines with unit bearing and gear circulating system.
   (b) Gears on geared turbines with separate bearing and gear system.
2. **Marine Turbines**
   (a) All bearings direct connected with circulating system.
   (b) High Speed Single Reduction Gears on geared turbines with unit bearing and gear circulating system.
   (c) Single Reduction Gears or Primary Gears of Double Reduction on geared turbines with two independent bearing and gear circulating systems.
   (d) Propeller motor bearings with circulating or ring oiling system on Turbine-electric Drive.

* **CORROSION**
(RUST)

Have you received your copy of "Lubricania"?

This informative handbook, "Tide Water Associated Lubricania", gives a clear, concise description of the basic tests used to determine important lubricant properties — Corrosion, Flash Point, Pour Point and many others. For your FREE copy write to: Tide Water Associated Oil Co., 17 Battery Pl., New York 4, N. Y.

DRUMS! DRUMS! DRUMS!

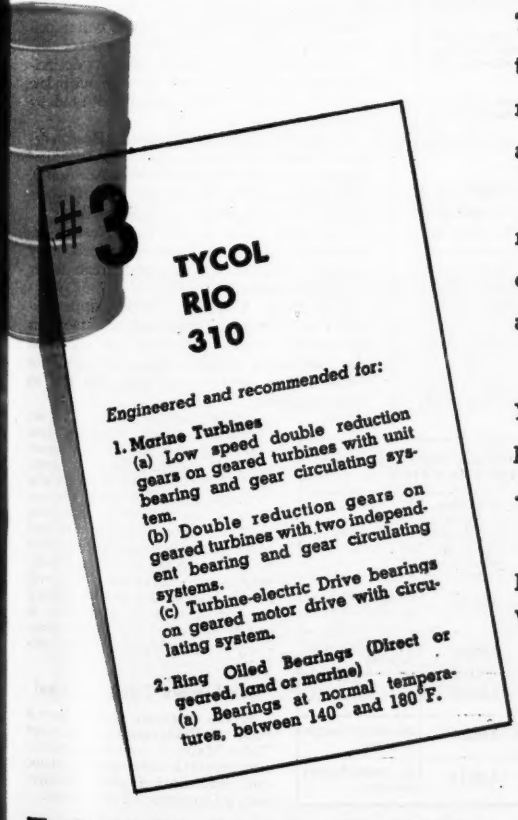
War needs make it extremely important that all empty drums be returned promptly.

TIDE WATER

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL
Eastern Division:
17 Battery Place, New York 4, N. Y.

...oxidation

3 NEW TYCOL RIO TURBINE OILS


#3
TYCOL
RIO
310
Engineered and recommended for:
1. Marine Turbines
(a) Low speed double reduction gears on geared turbines with unit bearing and gear circulating system.
(b) Double reduction gears on geared turbines with two independent bearing and gear circulating systems.
(c) Turbine-electric Drive bearings on geared motor drive with circulating system.
2. Ring Oiled Bearings (Direct or geared, land or marine)
(a) Bearings at normal temperatures, between 140° and 180°F.

These new Tycol RIO oils are an extremely valuable contribution to satisfactory turbine performance. Their remarkable purity of refinement – their endurance in service – and their high rust and oxidation inhibiting qualities is a matter of record.

Long and exhaustive tests in actual turbine units – units already showing definite rust development when operated on conventional type oils – prove the efficiency of RIO oils . . . both as an economical lubricant, and rust inhibitor.

Therefore, if moisture is a factor in your turbine operations, you can depend on RIO oils, with their high rust inhibiting properties, to provide unqualified protection against corrosion . . . without loss of valuable lubrication efficiency.

Tide Water engineers are thoroughly experienced in all phases of turbine lubrication. Call or write the nearest Tide Water Associated office for expert advice and help in selecting the Tycol lubricant best suited to your specific need.

ASSOCIATED OIL COMPANY

Principal Branch Offices:
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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Arsenic as a Corrosion Inhibitor... Increasing Condenser Tube Life

The rate at which condenser and heat exchanger tubing is attacked by corrosion may be influenced by the presence of a corrosion inhibitor in the liquid or in the metal or alloy itself. Therefore, it is worth the time of every power plant operator to have some knowledge of the importance of corrosion inhibitors. Since space is limited, this article is confined to a discussion of some of the benefits gained by adding the inhibitor, arsenic, to certain condenser tube alloys.

As far back as 1908, A. S. Dwight discovered that the addition of arsenic trioxide to cooling water contaminated by sulphuric acid from smelter fumes retarded the corrosion of steel jackets. In 1924 G. D. Bengough and R. May added arsenic trioxide to a solution of cupric chloride, and reported that it inhibited copper deposition (a reaction associated with dezincification) on 70-30 brass when the ratio of concentration of arsenic to copper in the solution was approximately 1 or more. Thus, arsenic was shown to affect the corrosion products of brass, and through them the corrosion rate of the alloy itself. As a result, Bengough and May undertook further experiments to determine what effect the addition of certain elements to the metal itself would have on the dezincification of brass. They discovered that 70-30 brass containing as little as .02% arsenic resisted dezincification, and that even .01% arsenic was effective. Another investigator, C. F. Nixon, who conducted experiments during the same year, reported that brass containing less than .3% arsenic showed great resistance to dezincification. A series of tests conducted in our own laboratories at Bridgeport have yielded interesting data regarding the effect of arsenic added to several condenser tube alloys. Two series of tests were run—one in artesian well water and another in sea water.

Artesian Well Water

These tests were conducted in slowly-flowing artesian well water heated to approximately 150° F. The water had a pH value of 5.3 (quite acid). ASTM sheet tension specimens cut from .050" thick sheets of Muntz Metal and Aluminum Brass were used. The depth of corrosion was calculated from the average loss in tensile strength after immersion for 120 days. The non-inhibited Muntz Metal was removed after 40 days because of excessive corrosion, and consequently its corrosion rate was multiplied by 3 in order to make the values comparable.

As may be seen from Table I, the addition of .02% arsenic to Muntz Metal practically eliminated dezincification and cut the general corrosion rate about one-third. In the case of Aluminum Brass, the addition of .02% arsenic practically eliminated localized dezincification, while the overall general corrosion rate remained about the same.

Alloy	Average Depth of Corrosion	Description of Attack
Muntz Metal	.043"	Dezincification fairly uniform with some deep penetrating plugs.
Arsenical Muntz Metal	.012"	No dezincification. General uniform corrosion with a few minute pits.
Alum. Brass	.0006"	Scattered plug type dezincification, with large deep plugs completely penetrating the specimens.
Arsenical Alum. Brass	.0005"	General uniform corrosion with slight roughening of the surface.

Sea Water Tests

Samples of Admiralty, Muntz Metal and Naval Brass were immersed for one year in clean moving sea water. The test was conducted with ASTM sheet tension specimens .050" thick with bakelite rods and spacers to prevent any possibility of galvanic corrosion. Results indicated that the addition of .04% arsenic to Admiralty not only helped inhibit dezincification, but also lowered to a small degree the overall corrosion rate. The addition of .10% arsenic to Muntz Metal inhibited dezincification in sea water to a marked degree. In fact, that amount of arsenic had an effect almost equal to that of .75% tin which, in that amount, also acts as a dezincification inhibitor. Table II summarizes the results of these tests.

Effect of Arsenic as an Inhibitor of Dezincification when alloys are tested in flowing Sea Water for 1 year (Average of 4 tests)

Alloy	Depth of Penetration Based on Loss in Tensile Strength Inches per year, ipy	Depth of Penetration Based on Loss in Weight in inches per year, ipy.	Remarks
Plain Admiralty Metal	0.00283	0.00178	Uniform with trace of dezincification
Arsenical Admiralty	0.00237	0.00160	No dezincification detected
Plain Muntz Metal	0.00688	0.00229	Badly dezincified
Arsenical Muntz Metal	0.00309	0.00210	No dezincification detected
Naval Brass	0.00261	0.00183	No dezincification detected.

Arsenic In Bridgeport Alloys

It will be observed from the foregoing that the use of arsenic as a corrosion inhibitor has been known for a number of years. The results of field and service tests have proved the soundness of Bridgeport's policy of adding arsenic to Cuzinal (aluminum brass), Admiralty, Muntz Metal and some other alloys to inhibit dezincification and increase service life. Listed below are Bridgeport standard condenser tube alloys to which arsenic has been added to increase service life.

Duronze IV (approximately 95% copper 5% aluminum, with a trace of arsenic) considered one of the finest condenser tube alloys made. Resists general corrosion and air impingement corrosion. Especially recommended for seaboard power stations using brackish water polluted by sewage and factory wastes.

Arsencial Admiralty—Resists dezincification and gives good service with low velocity fresh or salt water polluted by sewage.

Cuzinal (aluminum brass)—Resists dezincification. Has more resistance to air impingement corrosion than does Admiralty, and consequently is suitable for use where higher velocities of water are used.

Arsenical Muntz Metal—Resists dezincification. A moderately priced alloy suitable for use where good fresh water conditions exist.

Arsenical Copper—Pure copper alloyed with a small amount of arsenic is apparently more resistant to corrosion than ordinary copper. Recommended for fresh water condensers and for use as heater tubing.

Bridgeport's laboratory has accumulated much valuable data regarding the life of condenser tube alloys under service conditions. This data should be of value to power plant operators who are considering retubing, and who wish to obtain longer life and more satisfactory service than they have in the past. Your nearest Bridgeport representative will be glad to make our laboratory services available and help in the selection of the proper alloy for your particular water conditions.

Condenser Tube Manual

Every engineer should have a copy of Bridgeport's Condenser Tube Manual, containing corrosion research data, specifications, and information about Bridgeport's Condenser Tube Alloys.

Note: Bridgeport products are supplied in accordance with existing priority regulations

BRIDGEPORT BRASS

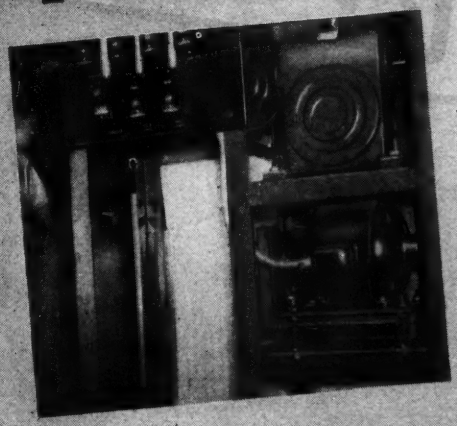
BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ESTABLISHED 1865

IN STUFFY SPOTS

Many a motor must be located where walls, adjacent equipment, or materials cut down the free flow of air. Sometimes, as in the case of this wool-dryer drive, surroundings are hot, and stuffy, too.

Tri-Clad motors have proved themselves cool-running even under such conditions. Their powerful, double-end ventilating system moves the air at controlled velocity for effective heat removal. The location and baffling of dual exhaust ports discourage recirculation.



Tri-Clad motor drives conveyor on wool dryer—Bigelow Sanford Carpet Co., Amsterdam, N. Y.

AIR-FLOW TESTS OF TRI/CLAD MOTORS LEAD TO PROTECTION FROM OVERHEATING

REG. U.S. PAT. OFF.

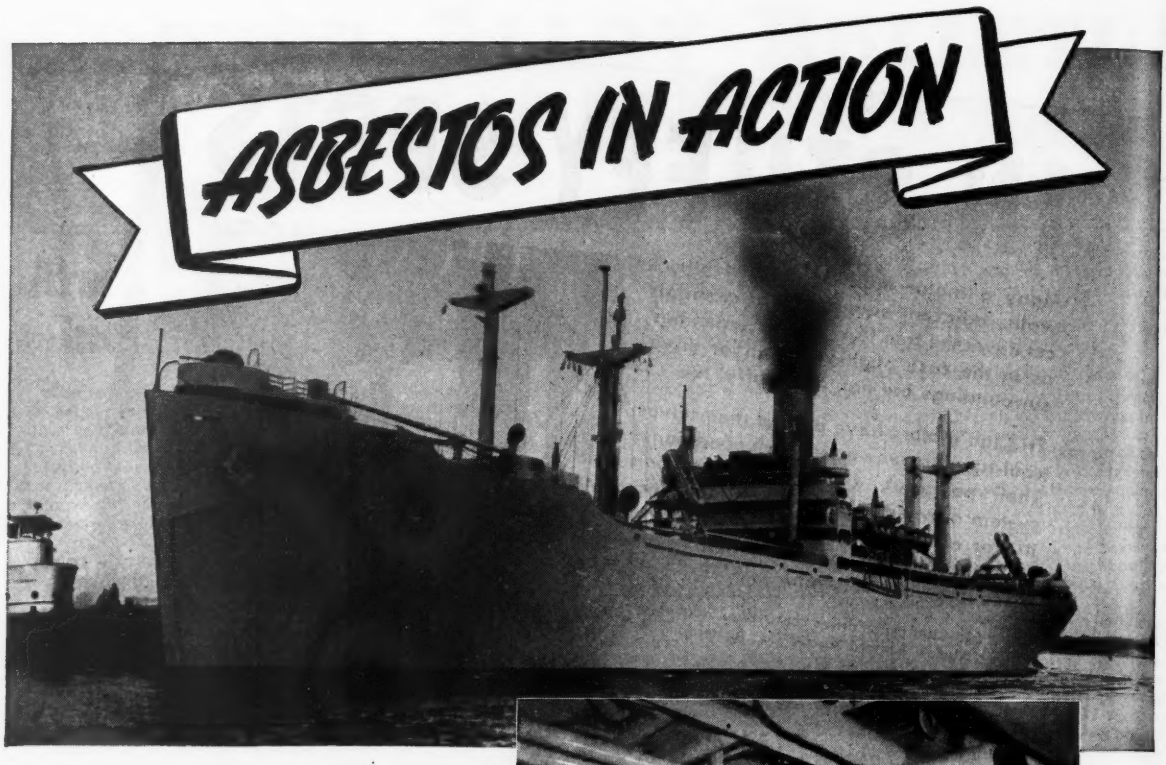
Plenum chamber test of Tri-Clad motor ventilation at G-E motor factory.

Before new types or sizes of Tri-Clad motors are approved for production, plenum chamber tests are conducted on the ventilating systems of sample models. These measurements serve as a check on previous calculations of the volume and velocity of air through the motor under different conditions. Other tests under load within enclosures and at abnormal ambient temperatures are also made. If your motors must be confined in stuffy spots, G.E. can help you make the right choice to beat the heat. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

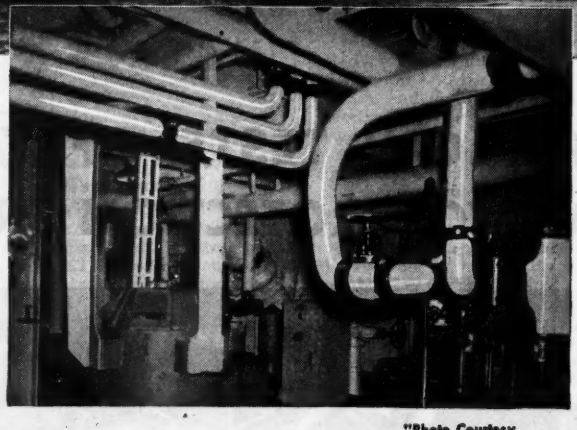
TRI/CLAD MOTORS

Buy all the BONDS you can—*and keep all you buy*



Saving precious fuel and steam

K&M "FEATHERWEIGHT" *85% Magnesia*



"Photo Courtesy Armstrong Cork Company"

Every intricate bend of the steam piping to pumps and apparatus in the engine room of this cargo vessel is tailored uniformly with K&M "Featherweight" 85% Magnesia. This widely used pipe covering combines the high insulating properties of basic Carbonate of Magnesia with strong Asbestos Fibres, and is designed for pipes carrying temperatures up to 600° F. It is extremely light in weight and it delivers maximum efficiency.

In one shipyard alone, 250 cargo vessels of the Liberty and faster 16 knot Victory type (pictured above) have been insulated by the skilled coverers of the Armstrong Cork Company, distributors of K&M "Featherweight" 85% Magnesia.

K&M "Featherweight" 85% Magnesia is giving this same kind of dependable service—these same heat and fuel savings—in power plants and industrial process plants all over the country. In fact, from the time 85% Magnesia Insulation was first developed by K&M more than sixty-five years ago, the name "Featherweight" has been a byword for quality with plant operating men.

ARMY E NAVY

K&M best in asbestos

YOUR MERCHANT MARINE SAVED US DURING WAR—LET IT SERVE YOU DURING PEACE

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

LESS LEAKAGE WITH LARGER CLEARANCES Sustains Efficiency

Look for DE LAVAL LABYRINTH RINGS

De Laval Labyrinth Wearing Rings contribute in a large measure to sustaining the high efficiency of De Laval pumps. The large clearance, tortuous labyrinth passage reduces leakage to a minimum and maintains ample running clearances under all conditions.

For sustained efficiency and reduced maintenance costs look for De Laval Labyrinth Wearing Rings when buying centrifugal pumps.

3235

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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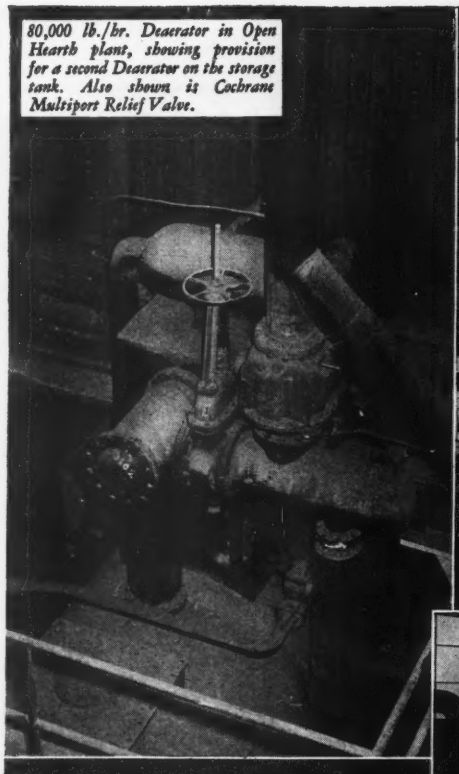
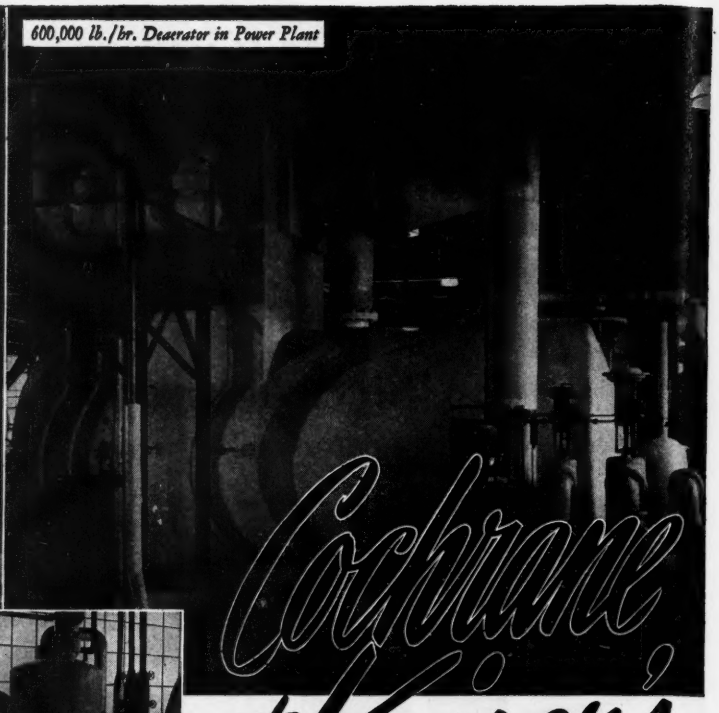
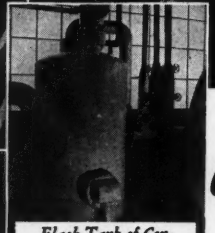


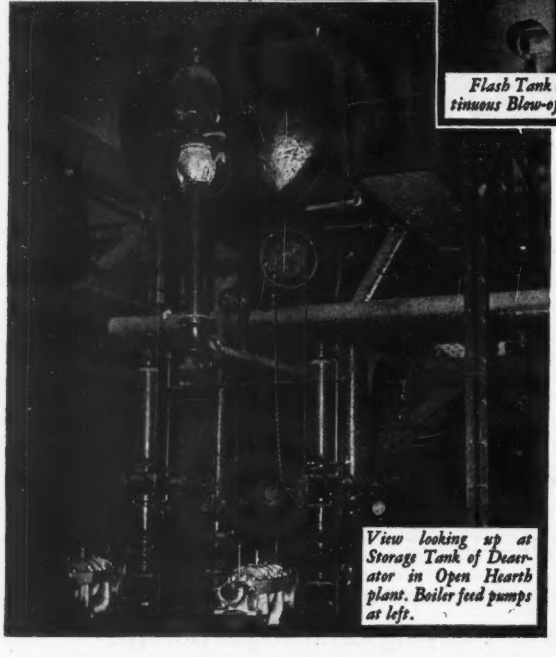
80,000 lb./hr. Deaerator in Open Hearth plant, showing provision for a second Deaerator on the storage tank. Also shown is Cochrane Multiport Relief Valve.



600,000 lb./hr. Deaerator in Power Plant



Flash Tank of Continuous Blow-off System.



View looking up at Storage Tank of Deaerator in Open Hearth plant. Boiler feed pumps at left.

Cochrane at Kaiser's

STEEL MILLS

FONTANA • CALIFORNIA

The great modern steel plant designed and erected by the Kaiser Company, Inc. at Fontana, California has a power plant in keeping with its other ultra modern equipment.

Noteworthy is the Cochrane 600,000 lbs./hr. Deaerator mounted on a horizontal cylindrical storage tank, delivering oxygen-free feed water to the boilers, which generate the steam supply for Coke Ovens, Blast Furnace, Open Hearth and Rolling Mills. Another Cochrane Deaerator of 80,000 lbs./hr. capacity is located in the basement of the Open Hearth plant supplying oxygen-free make-up to the boiler, in which is used the waste heat from the Open Hearth furnaces. This deaerator is mounted on a horizontal cylindrical storage tank, which has provision for mounting a second deaerator of equal size. A Cochrane Continuous Blow-off System serving 3 boilers is also installed in the Power Plant.

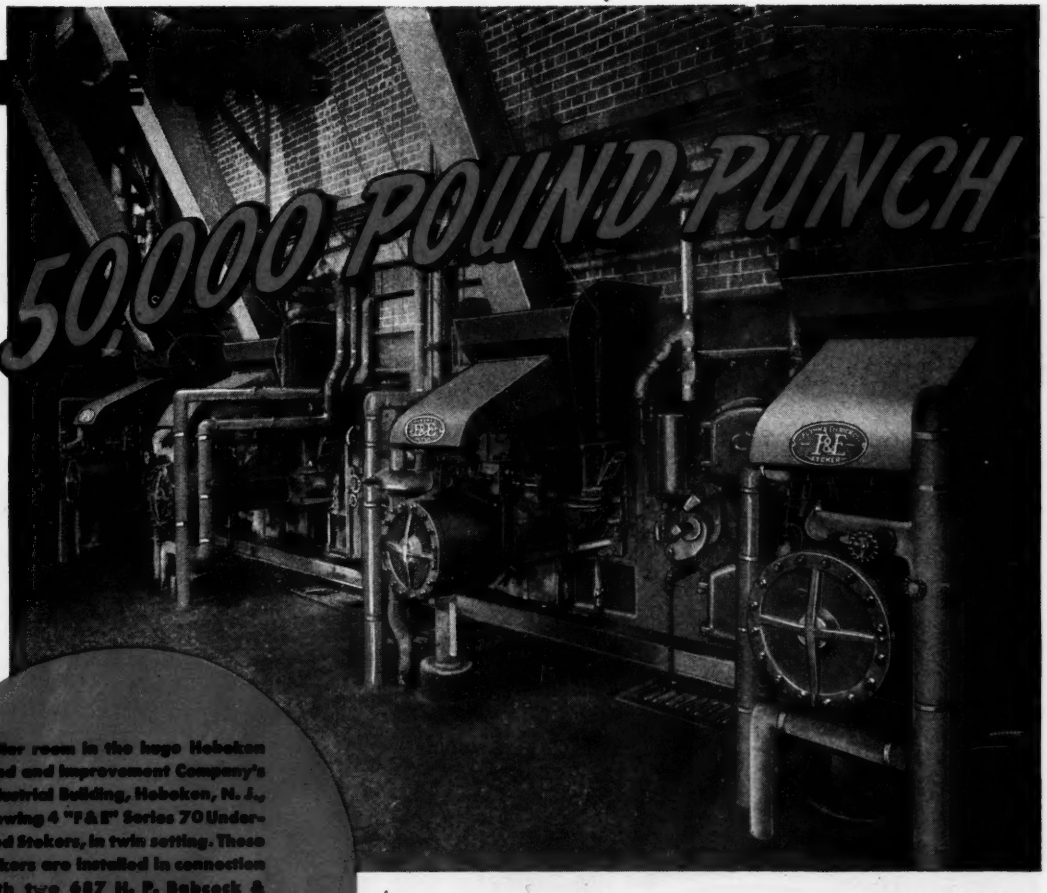
COCHRANE CORPORATION • 3123 N. 17th ST. PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

DE

A 50,000 POUND PUNCH



Boiler room in the huge Hoboken Land and Improvement Company's Industrial Building, Hoboken, N. J., showing 4 "F&E" Series 70 Underfeed Stokers, in twin setting. These stokers are installed in connection with two 687 H. P. Babcock & Wilcox horizontal water tube boilers. They are designed to produce 44,000 lbs. of steam per hour continuously during each day and 50,000 lbs. of steam for two hour peaks.

DRIVING POWER

TO PRODUCTION GOALS!

The concentrated purpose of the "F&E" combination of engineered features is *dependable, trouble-free production of steam power.*

Designed expressly for industrial boilers in plants and large buildings where power controls production, "F&E" Underfeed Stokers, Series 70, are built for rugged service.

Meeting the power demands of continuous daily schedules or peak loads, "F&E" Stokers assure positive control of power production through accurate regulation at all coal feeding and air supply rates. The "F&E" Steam Drive is recognized as a most simple, direct and economical drive. Operating with steam from the boiler direct to the stoker ram, all intermediate driving equipment is eliminated.

See your consulting engineer or local "F&E" Representative who can give you complete details and data on "F&E" Stokers for large and small industrial and commercial uses.

FLYNN & EMRICH CO.

Established 1862

HOLLIDAY AND SARATOGA STS., BALTIMORE 2, MD.

Representatives in Principal Cities

F&E **UNDERFEED STOKERS**

HYDRAULIC DRIVE AND STEAM DRIVE FOR BOILERS PRODUCING 10,000 TO 50,000 LBS. OF STEAM PER HOUR

TRY THIS ON FOR SIZE

MAYBE your packing requirements are freaks. If so, R/M makes over 70 different types of packing, and each one in a wide variety of sizes for practically every type of equipment.

Spiral packing, rings, spools and coils are available from 1/8" diameter to 2½". They are also available in round, square, and oval cross-section. Also with or without wire reinforcing.

R/M packing is designed to end dripping and leaking in pumps, engines, valves, compressors, wherever fluids or gases are being handled.

Talk to your distributor about the R/M packing, made for your particular packing needs. Ask for a copy of the R/M packing book.

It's "Packed with Satisfaction"—When You Use R/M

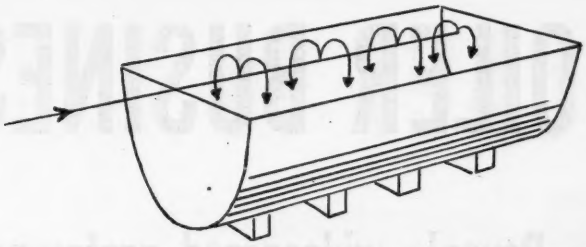
INDUSTRIAL SALES DIVISION

RAYBESTOS-MANHATTAN

INCORPORATED

Manheim, Penna. · Bridgeport, Conn.
North Charleston, S. C. · Passaic, N. J.

The Problem —
To distribute coal evenly to all parts of long bunker



And Here's the S-A *Answer*

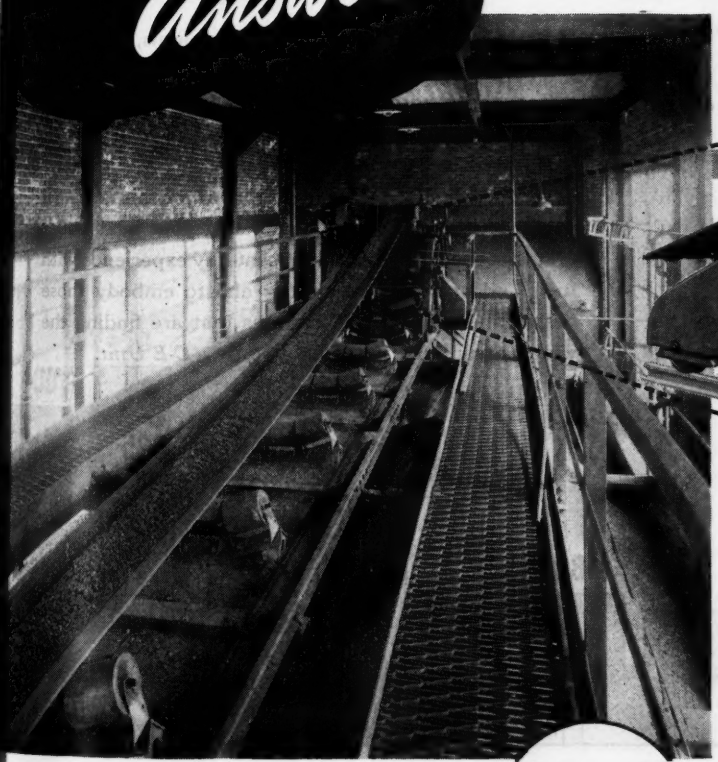
Whatever your coal handling problem, there's an S-A answer that means full efficiency at every handling step.

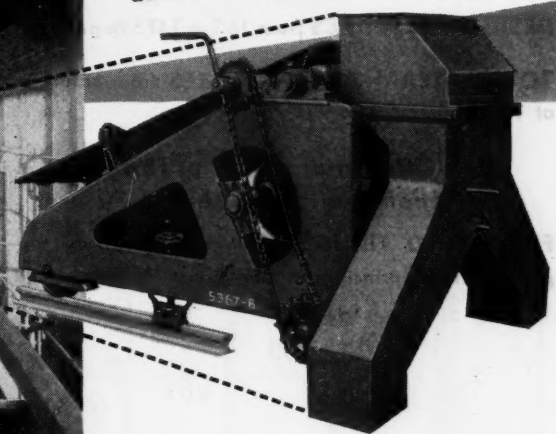
That's a broad statement, but one which S-A has backed up many times with actual time and money saving installations.

Here, the specific problem was utilizing the full capacity of a bunker. And the specific answer was an S-A Belt Conveyor traveling the entire bunker length, with coal discharging through an S-A Tripper.

Now as coal is carried along the belt, it can be discharged to both sides, to distribute coal evenly throughout the bunker and utilize full bunker capacity.

The next time you plan improvement or extension of your present coal handling system, get S-A's slant on how it can be done most efficiently.





Above: Close-up view of one of several styles of S-A Conveyor Belt Trippers, a simple, sturdy tripper for use on moderate size installations. Tripper can be driven from either side.

Left: View down the coal bunker, showing S-A Self-propelling, Self-reversing Tripper at far end. Tripper straddles belt for entire bunker length, with spout discharging to both sides.

STEPHEN S-A ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS / LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

BOILER BUSINESS placed in

Reveals widespread preference for C-E Equipment

DURING the first three months of this year, many leading industrials and utilities placed orders for new steam generating units. Their conclusions as to present-day values offered by the principal boiler manufacturers are revealed in the fact that a far larger volume of this first quarter's business was placed with Combustion Engineering than with any other company in the field. Equally significant is the fact that this preference for "C-E engineered" equipment extended through virtually the entire range of steam generating conditions:

CAPACITIES from 15,000 to 600,000 lb of steam per hr.

DESIGN PRESSURES from 160 to 1475 lb per sq in.

TOTAL STEAM TEMPERATURES from saturated at 160 lb pressure to 935 F.

Other indications of the comprehensiveness of this work are:

FUELS AND FIRING — Bituminous coal as supplied from all principal mining areas, anthracite, oil, gas, bagasse, wood refuse, soda tar and acid sludge. Pulverized coal and three types of stokers are represented in the coal-fired group which comprises slightly more than half the number of units. Combination firing of pulverized coal, oil and gas is employed in one unit, and three units are designed to burn both oil and gas.

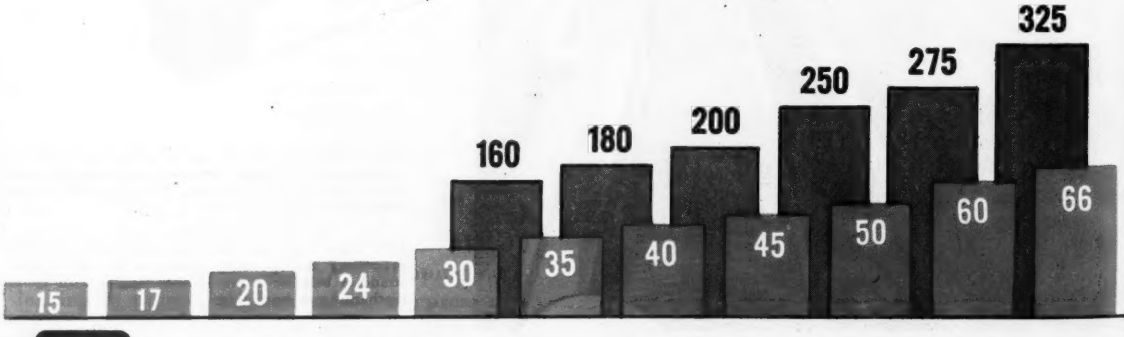
GEOGRAPHICAL — Units will be installed in the following states: Conn., N. Y., N. J., Pa., Md., Va., N. C., Fla., Ind., Ill., Mich., Wis., Minn., Mo., Kan., Ark., Colo. and Tex.; also in five Latin American countries.

INDUSTRIES — Public utility power plants, munitions, rubber, petroleum, chemicals, paper, textile, food products, sugar, tobacco and miscellaneous manufacturing.

★ ★ ★

The conclusion to be reached from all of this is that if you want the equipment comprising your next boiler unit to reflect the broadest present-day experience with fuels and operating conditions and to embody those design and construction features that are finding the widest acceptance in the field — *buy a C-E Unit.*

A-874

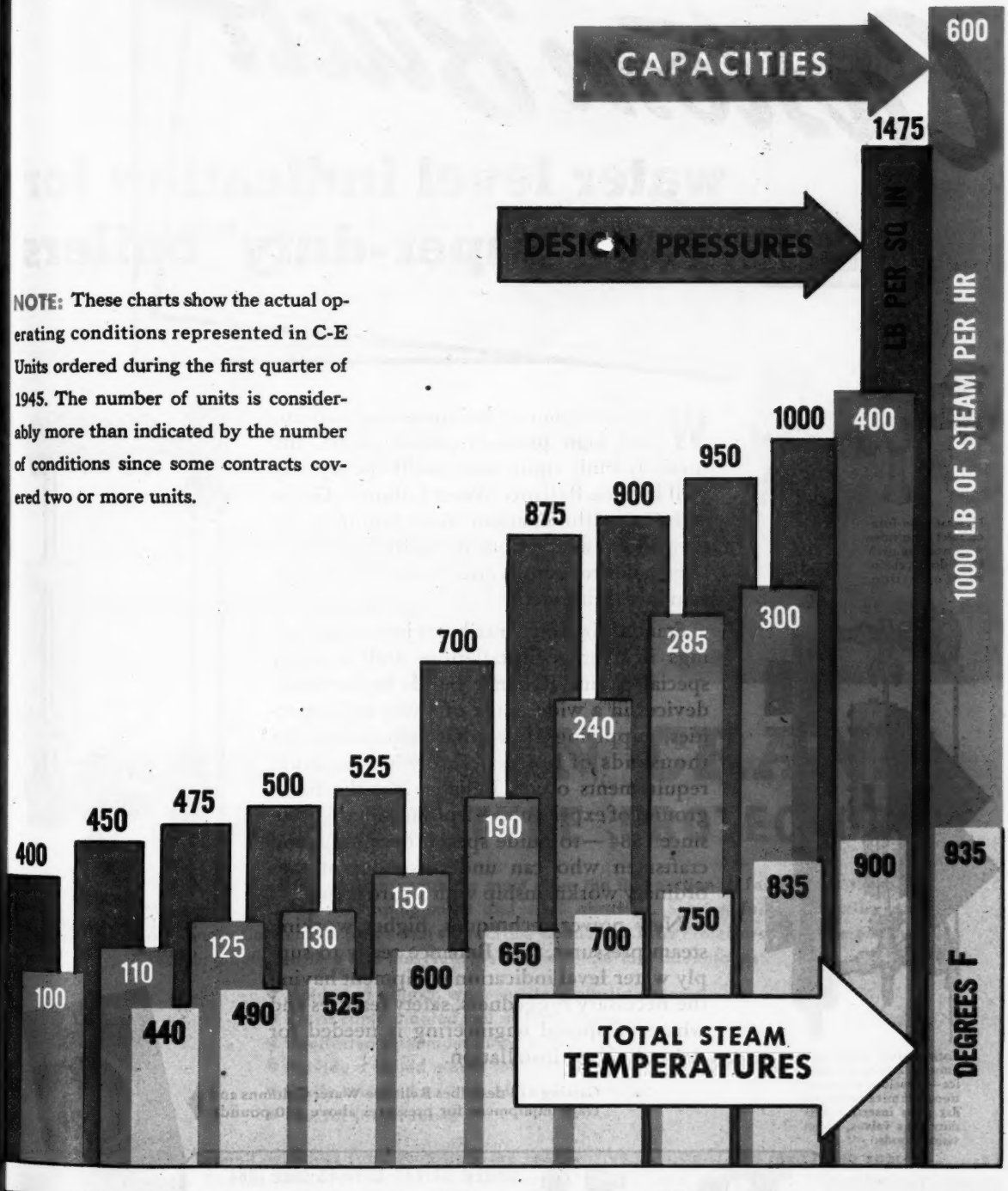


C·E

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

FIRST QUARTER of 1945



NOTE: These charts show the actual operating conditions represented in C-E Units ordered during the first quarter of 1945. The number of units is considerably more than indicated by the number of conditions since some contracts covered two or more units.

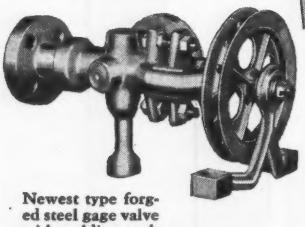
ENGINEERING

200 Madison Avenue New York 16, N. Y.

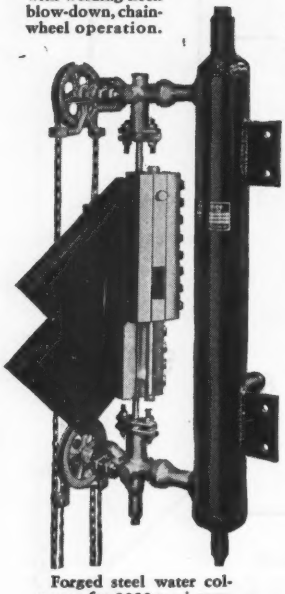
It will pay you to specify Reliance

Custom Built

water level indication for your "super-duty" boilers



Newest type forged steel gage valve with welding neck blow-down, chain-wheel operation.

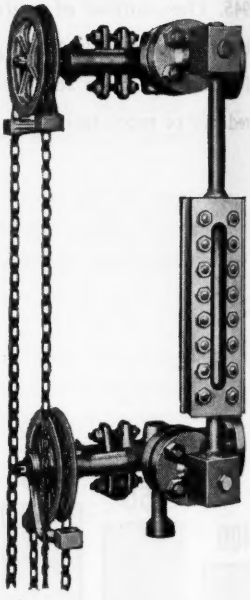


Forged steel water column for 2000 p.s.i. service—all welded construction, with mica-protected flat glass insert, heavy-duty gage valves, direct vision hoods.

WHEN you plan or design new or modernized high pressure power plants, the specially built equipment you'll specify may well include Reliance Water Columns, Gages and Gage Illumination. Your requirements may call for adaptations skillfully engineered to gain desired results not obtainable through standard equipment.

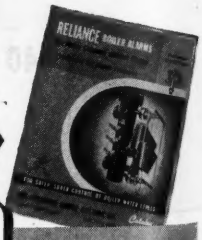
Standardization contributes important savings in average installations and in many special plants. Reliance builds boiler safety devices in a wide range of styles and capacities, supplying appropriate equipment for thousands of boilers. But when unusual requirements occur, Reliance has the background of experience—a pioneer in this field since 1884—to guide special designing, and craftsmen who can undertake out-of-the-ordinary workmanship with a sure hand.

New power techniques, higher working steam pressures, find Reliance ready to supply water level indication equipment having the necessary ruggedness, safety features and whatever special engineering is needed for the individual installation.



Special gage assembly for direct-to-drum operation.

Catalog 415 describes Reliance Water Columns and Gage Equipment for pressures above 250 pounds.

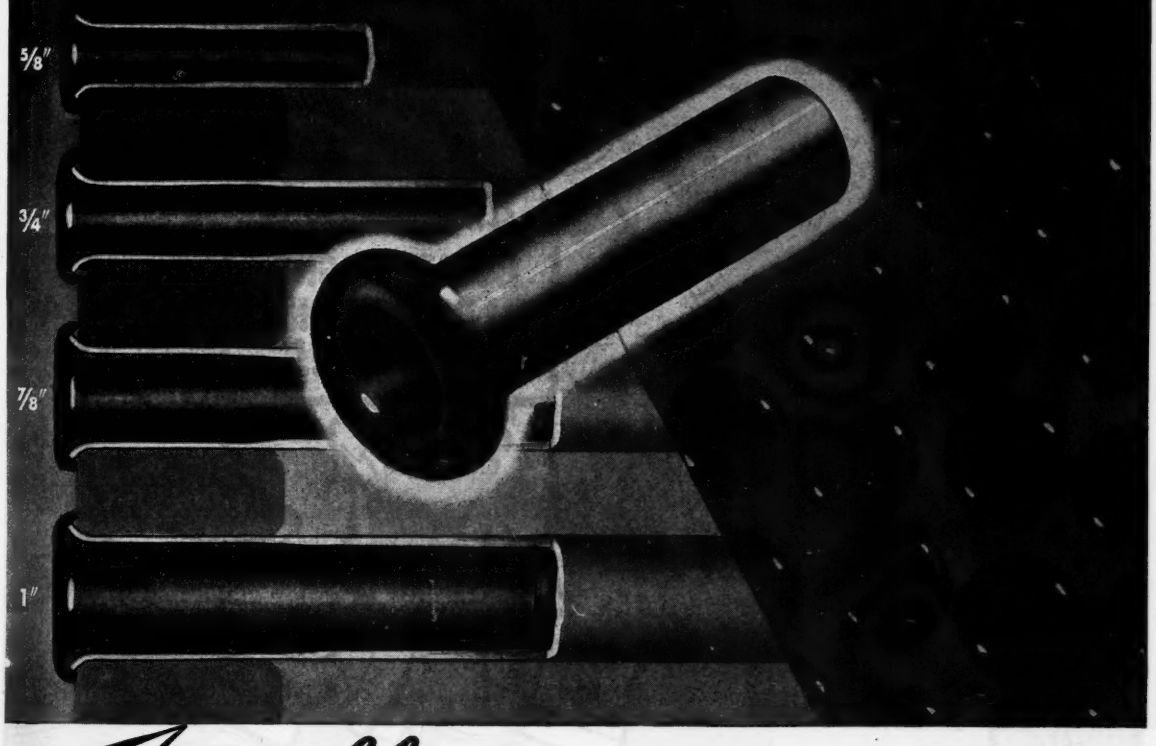


BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

Save CRITICAL TUBE METAL



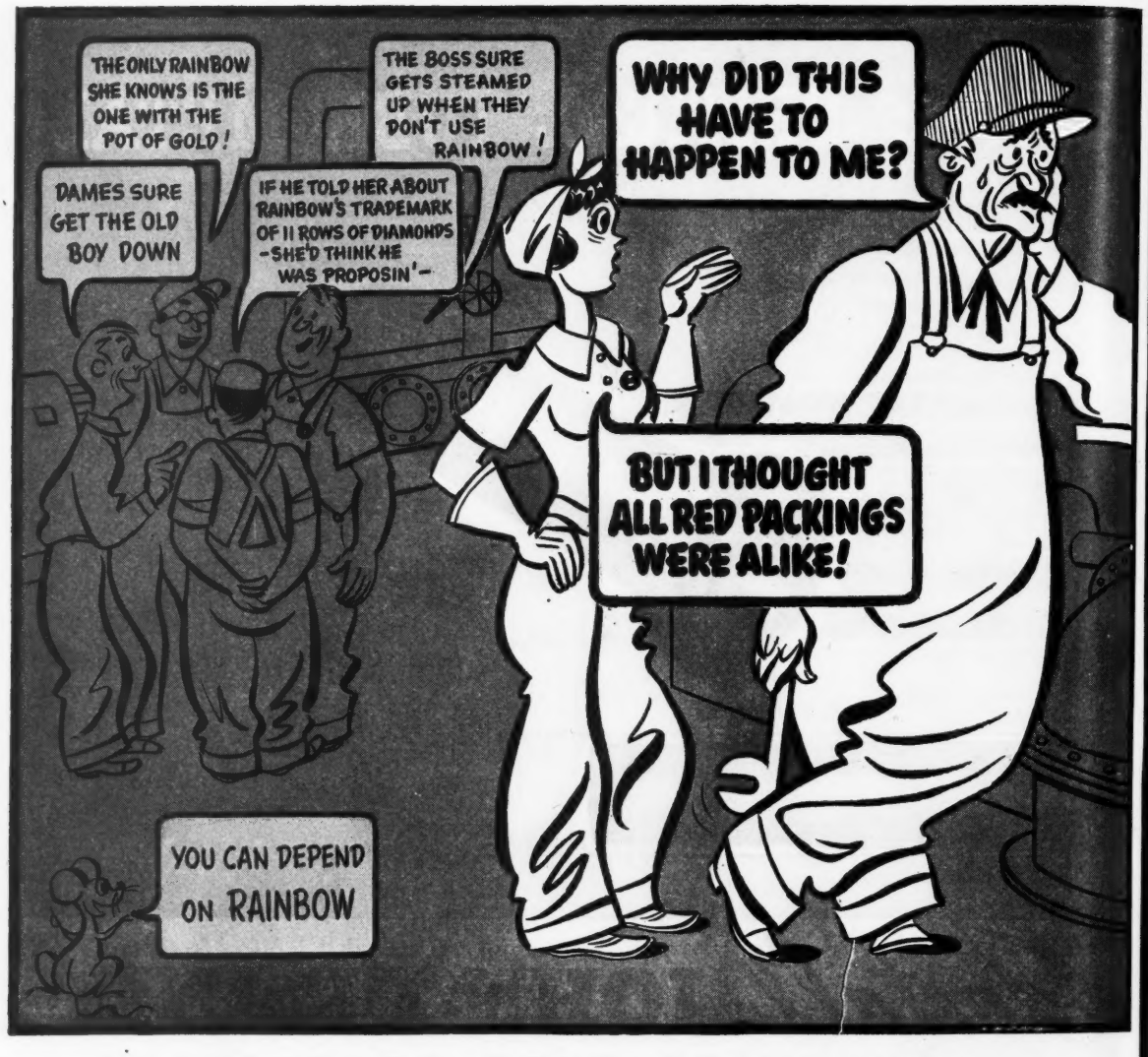
Install JOHN CRANE
CONDENSER TUBE PROTECTORS

The inlet end of the condenser tube is most often the first section to fail. This is the area most vulnerable to air impingement and sand abrasion. Service Tests in Marine and Stationary Condensers prove that John Crane Condenser Tube Protectors *armor the entrance section; greatly lengthen tube life.* Note these other important advantages:

- **Molded of a hard, wear-resistant plastic material**
- **Resist contaminated salt or fresh water**
- **Unaffected by temperatures to 275° F.**
- **Provide a belled mouth for inlet tube ends; reduce turbulence**
- **Easily installed on both old and new tubes**
- **Last for life of tubes**

John Crane Condenser Tube Protectors are inexpensive to install; and require no special tools. Available for 5/8" and 3/4" 16-BWG, or 5/8", 3/4", 7/8" and 1" 18-BWG tubes. For full information send for *illustrated* bulletin, or consult our branch office *nearest* you.

CRANE PACKING COMPANY
1812 CUYLER AVENUE • CHICAGO 13, ILLINOIS


THE ONLY RAINBOW SHE KNOWS IS THE ONE WITH THE POT OF GOLD!
THE BOSS SURE GETS STEAMED UP WHEN THEY DON'T USE RAINBOW!
WHY DID THIS HAVE TO HAPPEN TO ME?
DAMES SURE GET THE OLD BOY DOWN
IF HE TOLD HER ABOUT RAINBOW'S TRADEMARK OF 11 ROWS OF DIAMONDS -SHE'D THINK HE WAS PROPOSIN'-
BUT I THOUGHT ALL RED PACKINGS WERE ALIKE!
YOU CAN DEPEND ON RAINBOW

56 Years

OF DOING A BETTER PACKING JOB

When you're fighting a war, any production delay is serious. That makes Rainbow, the original red sheet packing, more valuable than ever. For Rainbow has been for 56 years the packing that will not squeeze or blow out in service.

Rainbow is designed for packing against hot or cold water, air, saturated steam pressures up to 150 pounds, and all hydraulic conditions. It insures a tight joint, fills up irregularities in the flange, overcomes normal vibration, expansion and contraction in a line.

Help keep your production steady —use Rainbow, the original red sheet packing.

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program, CBS network, Sunday afternoon, 3:00 to 4:30 E.W.T.

UNITED STATES RUBBER COMPANY

Serving Through Science

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, NEW YORK

Lifetime Service *with* SPRINGFIELD cast steel headers

Springfield water tube boilers are the only boilers with cast electric steel headers. Not a single case of pitting or corrosion has ever been reported in these headers! That is only one of the many advantages of this new design — check the other Springfield header features on the right.

Typical of the many "firsts" in Springfield design are: Staggered 4-tube grouping and small 3" diameter tubes, which assure high heat transfer efficiency; Across-Tube Baffles which reduce exit gas temperatures; Easy water level control — no variable steam space ahead of steam drum; Dry steam; High capacity close spaced Water Walls; Straight Tube design for easy maintenance, high reliability and safety with sectionalized construction.

Springfield boilers are available from 5000 to 500,000 lbs. per hour and higher capacity, and from 75 to 750 p.s.i. and higher. A Springfield is a modern, quick-steaming boiler, easy to operate and maintain, low in operating cost and high in operating efficiency. Contracts taken for complete steam generating units. Write today!

Springfield Boiler Company
1951 E. Capitol Ave.,
Springfield, Ill.

- Wider Variety of Header Designs For Every Application
- Tighter and Stronger Tube Connections
- Tensile Strength and Yield Point 25% Higher Than Forged or Wrought Construction
- No Seams or Crevices To Cause Caustic Embrittlement — Corrosion Resistant
- Increased Thickness of Sections and Reinforcing Ribs Possible With Cast Design.

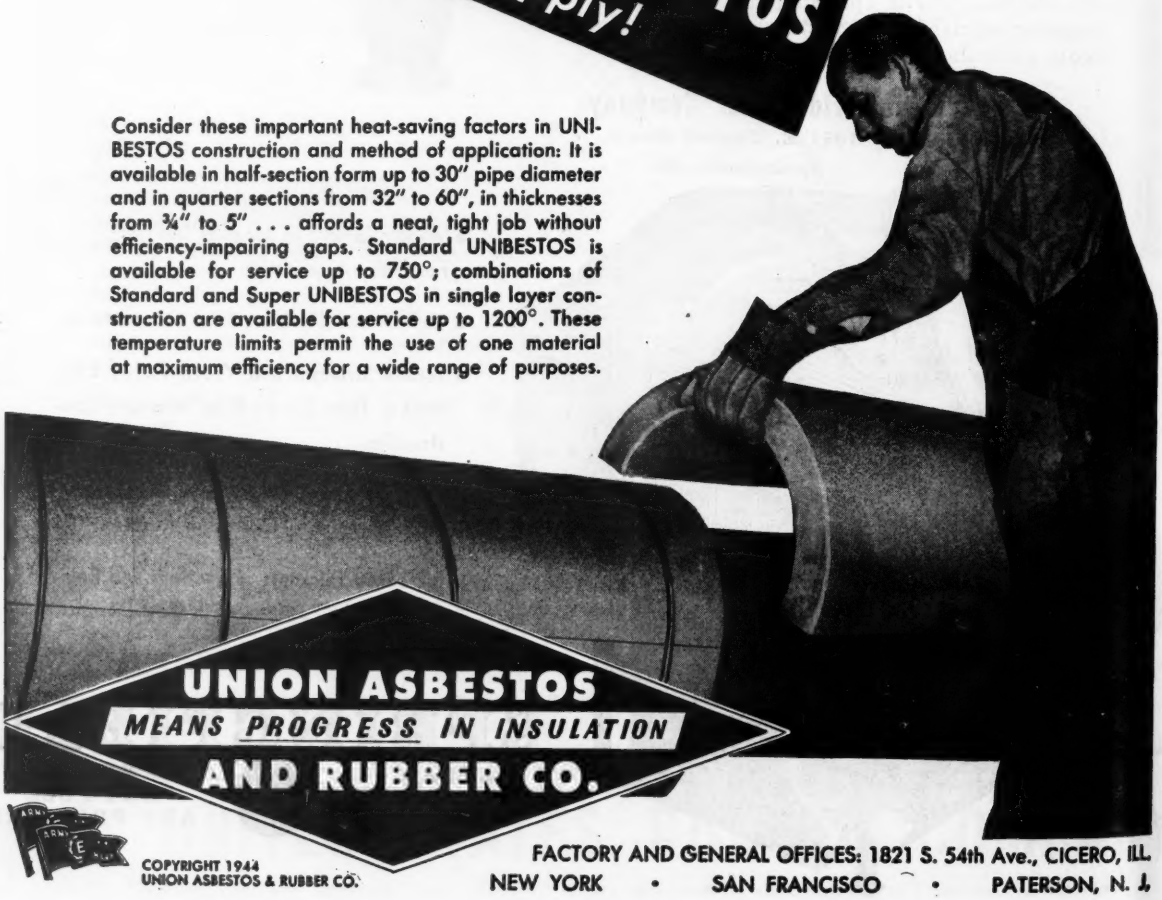
SPRINGFIELD
STEAM GENERATING UNITS
ANY SIZE ANY FUEL ANY PRESSURE

LOSING B.T.U.s?

SIMPLY APPLY UNIBESTOS

it's simple to apply!

Consider these important heat-saving factors in UNIBESTOS construction and method of application: It is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5" . . . affords a neat, tight job without efficiency-impairing gaps. Standard UNIBESTOS is available for service up to 750°; combinations of Standard and Super UNIBESTOS in single layer construction are available for service up to 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes.



UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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UNION ASBESTOS & RUBBER CO.

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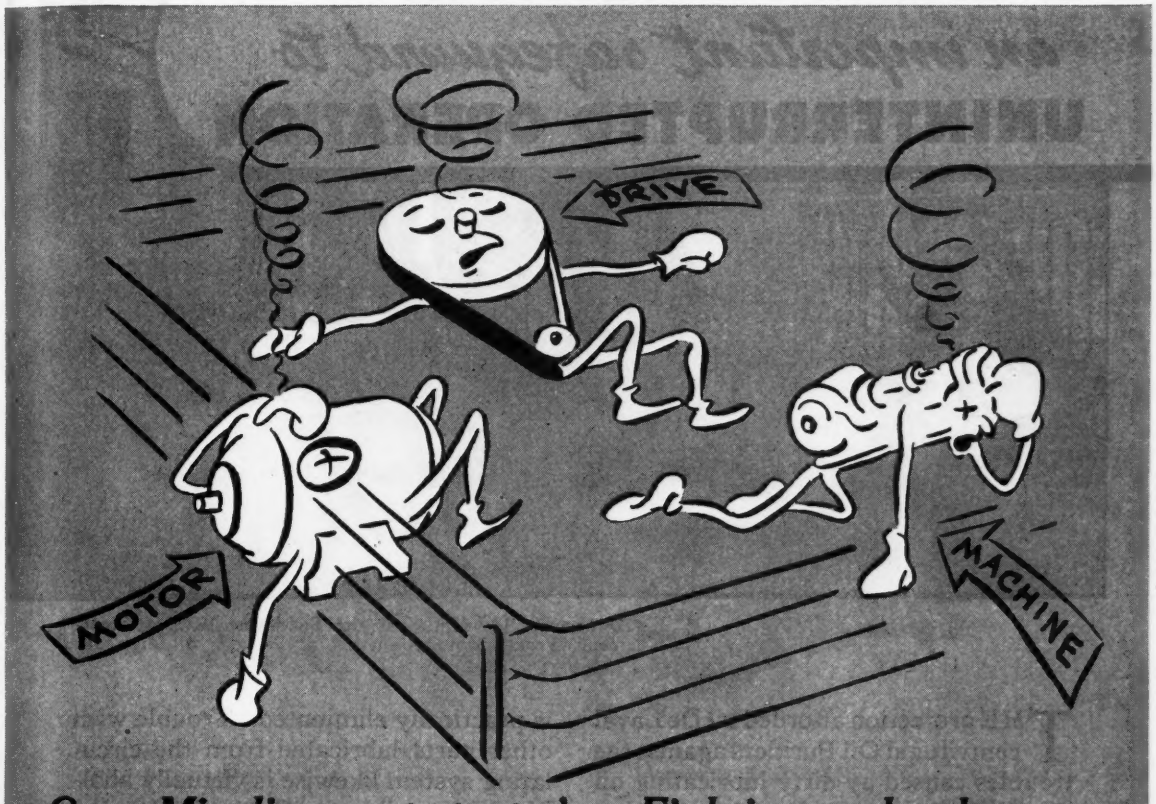
STOP THIS FIGHT!



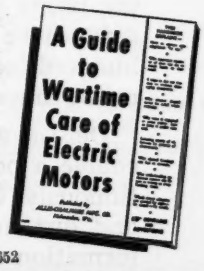
Once Misalignment starts 'em Fighting each other . . . the only Question is: Which will go First?

SPRUNG OR BROKEN shafts, burned-out bearings, overload failure—are cases of motor damage commonly caused by Misalignment. And the damage can occur in drive or driven machine, too. For when these elements are assembled in incorrect geometry, bending, breaking or excessive wear must result. *Something has to "give!"*

Picture above is from Allis-Chalmers' new "Guide to Wartime Care of Electric Motors" . . . which takes a fresh look at Misalignment *and the 8 other main enemies of motor life!*

Over 100,000 copies of this valuable new book are already in use by armed forces and industry. Applies to all makes—contains no advertising. Send for *your* free copy.

ALLIS-CHALMERS, MILWAUKEE 1, WIS.



A-1652

ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

A-C WE WORK FOR VICTORY WE PLAN FOR PEACE

DE LAVAL PROTECTION...
an important safeguard to
UNINTERRUPTED OPERATION

De Laval "Uni-Matic" at the Southwest Sewage Treatment Works, Sanitary District of Chicago, Stickney, Ill.

THE protection afforded by De Laval centrifugal Oil Purifiers against the troubles caused by dirty lubricating oil is a very important factor in making uninterrupted operation possible. Fortunately, in these times when most power sources cannot be spared from everyday duty, the great majority of the larger turbines in this country already have De Laval protection, as do hundreds of smaller turbines and other prime movers.

De Laval centrifugal Oil Purifiers enable a portion of the oil to be continuously by-passed, removing water and dirt and markedly retarding the formation of sludge. When the oil is thus purified, danger of bearing failure is practically eliminated. Trouble with other parts lubricated from the circulating system likewise is virtually abolished when oil is purified by De Lavals.

Whether a De Laval Oil Purifier by itself is used, or, in the case of turbines, a complete De Laval-Funk Process, the oil is maintained in a condition most nearly approaching that of new oil. Investigate for yourself these and other advantages of De Laval centrifugal purification . . . no obligation.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6

DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19

THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

FOR MORE DEPENDABLE POWER PRODUCTION

May we interrupt..?

We can assist you with your post-war plans

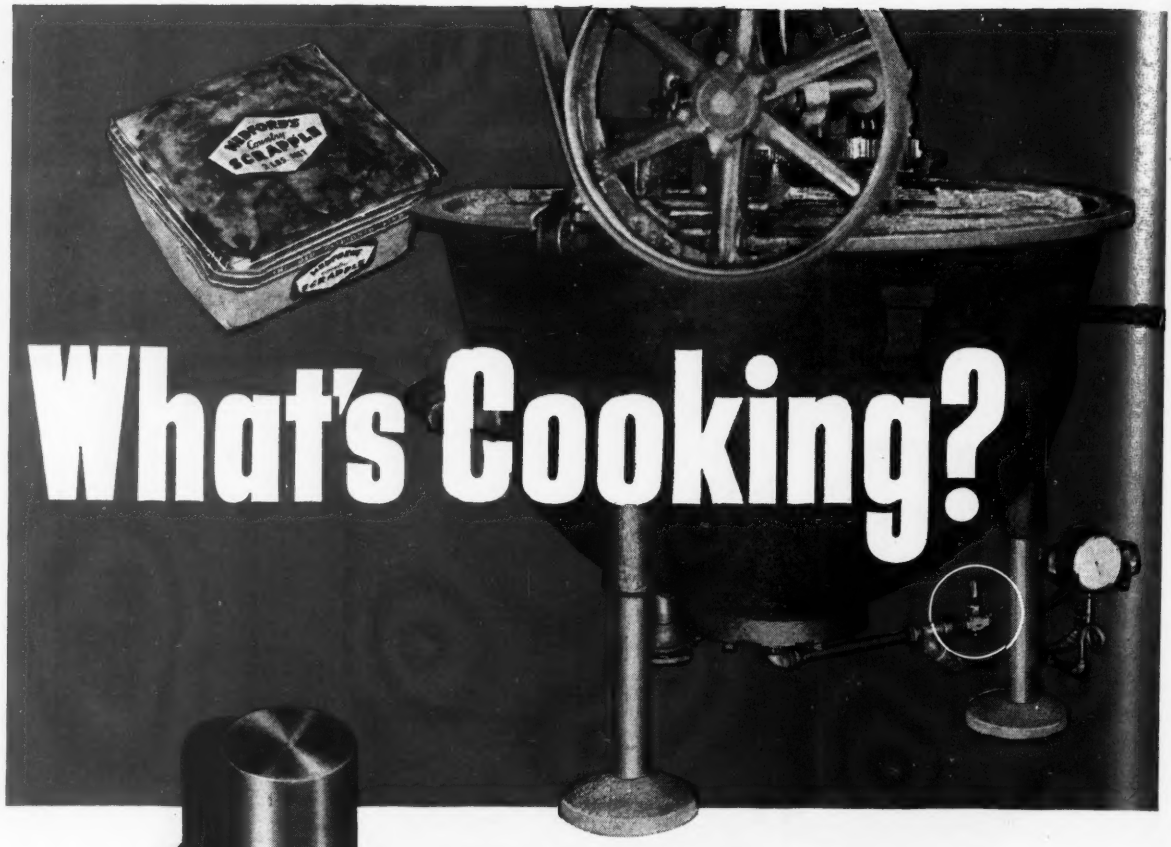
If you are thinking of the multi-story building you will build when the war is over — or

If you are among the thousands of progressive property owners and building managers who are thinking of modernizing their vertical transportation system when labor and materials are available —

We suggest that you get the planning behind you now as we have learned by experience that the preliminary plans for an elevator or escalator installation often take more time than is required for the manufacture and installation.

Your Otis representative is ready now to help you develop your elevator plans . . . to make preliminary studies and recommendations. Call him today and be assured of the last word in vertical transportation tomorrow.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES



FAMOUS COUNTRY SCRAPPLE . . . AND YARWAYS GET IT HOTTER . . . SOONER

At the Chester Packing and Provision Co. is made that famous Philadelphia specialty—country scrapple. And to get their large 600-lb cookers hot . . . in a hurry . . . Chester Packing has installed those famous Yarway Impulse Steam Traps.

With Yarways on the job, the cookers not only get hotter, sooner . . . they *stay hot.* That's because when the condensate load is heavy, Yarways discharge *continuously* until the lines and jackets are cleared. Then when the equipment reaches working temperature the discharge is *intermittent,* keeping it at peak efficiency.

There is a minimum of maintenance with Yarways. They have but one moving part, a simple valve . . . no floats, buckets, bellows or diaphragms. The trap body is machined from cold rolled steel bar stock and cadmium plated . . . rugged, built to *last.*

For your own plant consider this fact—it often costs no more to replace with new Yarways than to repair other type traps.

Over 400,000 Yarways have already been purchased. See your nearby Mill Supply Dealer or write for Bulletin T-1739.

Ask about the new Yarway 30-minute color motion picture, with Lowell Thomas, available for group showings.

YARNALL-WARING CO., 114 Mermaid Ave., Phila. 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Decentralization of Power

By SENATOR JOSEPH C. O'MAHONEY

IF A MODERN Marco Polo should suddenly return from the discovery of some new land hitherto hidden from the eye of man, he could bring American business men to their feet cheering were he to report the presence in that land of 50,000,000 people wanting and capable of using the things American business makes and sells.

It may sound fantastic, yet there is right here within our own country an even greater undeveloped market than this imaginary land. The South and West and indeed the teeming cities of metropolitan America contain more than fifty million people who do not have to be taught to appreciate what modern American industry can produce. They want the things the American businessman makes and wants to distribute. The great West is filled with natural resources still largely untapped. Neither these markets nor these resources have been developed to anything like their potential richness.

It must be demonstrated after the war that there is no basis for the growth of sectionalism in America, and that demonstration can be brought about only by the liberation and the development of the West and the South by the extension to these areas of economic opportunity unrestrained by any political or financial regimentation from the East.

Would it surprise you to know that 30 "billion dollar" corporations each had, in 1935, assets larger than most of our states? In fact only one state in all our West and South had, in 1937, property within its borders valued at more than the assets of either the Metropolitan Life Insurance Company or the American Telephone & Telegraph Company, both eastern corporations. Each of these two corporations is richer than any one of 38 sovereign states. And at the lower end of the scale there are 18 states none of whose total taxable wealth is as much as that of even the smallest of the 30 "billion dollar" corporations.

In thinking about the future of the United States, as of the world, these are facts of life which independent business men must remember, for the degree of economic centralization which has already occurred menaces private enterprise as it endangers the entire future of the world.

Everyone acknowledges that our business men have achieved tremendous and unparalleled industrial progress. The American standard of living exceeds that of any other nation or any other time. The rank and file of the people of our country enjoy luxuries which were denied to the wealthiest and most powerful only a few years ago. But the important thing is that though this is true, it is also true that the standard of living today is much more unstable than it was in the time of our grandfathers. A very large proportion of the people of our time are dependent for their livelihood upon conditions, organizations and tools over which they have no control.

Year by year business has become increasingly national in scope and the new national business has grown steadily more important to the everyday existence of all people in all localities. That made inevitable the growth of national laws, for no single local or state government could hope to set up controls for itself. They turned to Washington, D. C., for help.

That started a long march of events. From that day to this there has been a steady growth of the government establishments in Washington. Yet it would be a great mistake to assume that all this has taken place because politicians have wanted to take business over. It has grown because commerce must be regulated by government in the business interest, and nowhere except in the federal government is there an agency capable of such regulation.

Economic power which temporarily becomes so great that it can regiment men, enjoys only a temporary triumph, for it forces the creation of big government and ends up, as in Nazi Germany, in becoming subordinated to arbitrary political power.

In the creation of their international agreements private organizations do what the sovereign states themselves could never do, for business organizations enter into international cartel arrangements with foreign governments or with the corporate agencies of such governments.

The problem which faces us now is to keep our business organizations within bounds or accept some form of concentrated government. If government is not to become over-big, overpowerful and arbitrary, we must find the way to foster and encourage independent private enterprise.

So the circle continues to close. Small business has been swallowed by big business, and big business is now confronted with the danger of being swallowed up by government. The way to reverse this trend is not to be found in further expanding the powers of government nor in releasing big business from so called "government interference." The only remedy to save a democratic economy is to be found in making the economy democratic. If we are to avoid an all powerful central government we have no recourse but to reestablish and encourage free private enterprise—that is to say, private enterprise which will be free from the control of private organizations as well as of public organizations. What could do this? I recommend:

1. National charters for national corporations. Only so can we give these corporations a definite and free place in our economy. Only so can we reestablish local economic independence.

2. The effective and thorough enforcement of anti-trust laws to maintain competition and to prevent all combinations and agreements that destroy business.

3. The encouragement of new business and small enterprises by the revision of tax laws for the purpose of stimulating the investment of private capital, encouraging new employment and new industry.

4. Couldn't we start by calling a national conference of the various organizations representative of business, labor, agriculture and consumers? Each has been for years working on diverse phases of this central problem. Now public thought and action might be concentrated on the objectives on which there is general agreement instead of, as now, on the objectives on which there is only misunderstanding and disagreement.

Only by attacking and conquering the fundamental issues which cripple our economy can we open up economic opportunity for everyone.

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Senator Joseph C. O'Mahoney expresses in this article a highly controversial viewpoint which has a considerable following in many sections of the country. He has represented Wyoming since 1933, was Chairman, throughout its existence, of the joint Senate-House-departmental Temporary National Economic Committee (TNEC). He is also Chairman of the special subcommittee on Industrial Re-organization of the Senate Committee on Postwar Economic Policy and Planning, and a member of the Appropriations; Military Affairs; Judiciary and other committees. When he initiated the TNEC, he insisted on the word "temporary", because he wanted to make clear that the agency would do its job and then quit! The committee expired by operation of law on April 3, 1941, after almost three years of inquiry into the entire economic structure. This article was prepared for *Power Plant Engineering* through the Institute of Business Economics.

PHOSPHOR CONTROL

PHOSPHORS are the substances used on the inside of fluorescent lamp tubes and cathode ray tubes to transform invisible ultra-violet radiation or the energy of fast-moving free electrons into visible light. Basically, they are frequency changers, converting high frequency radiation into low frequency radiation. Despite their similarity as regards luminescence, phosphors vary considerably in their response to light stimulus. Some retain their phosphorescence for an appreciable time after the stimulus has been cut off; others are more instantaneous in their response and cut off almost instantly when the stimulus is removed. They also vary in color as shown by the different colors available in fluorescent lamps.

Obviously, it is of great importance that phosphors with the proper characteristics be selected for various purposes. As shown by the photograph, above, at the Dobbs Ferry, N. Y. plant of North American Philips Co., samples of luminescent materials covering a wide range of colors and characteristics are tested as a routine matter. An ultra-violet lamp not shown in the photograph, irradiates the phosphor and the fluorescent color and brightness is observed. The phosphorescent characteristics may be examined by switching off the ultra-violet lamp and observing the afterglow.

WITH THE EDITORS

Marine Life Ashore—Another consulting engineer we know has suggested that he would like the chance to design a stationary power plant using some of the 650 psi marine equipment that will be available after the war or might even be made available now for a high priority job. And he would like to have it operated by one of our many well-known engineers who were "brought up" at sea. There are many of them, as we all know, in both utility and industrial power plants all over the country. And there will be many more, we hope, after this war as the young men come back to us. However, a marine power plant on shore would certainly be interesting today in view of the service this equipment has been giving during this war.

All has not been perfect, of course. It never is. For security reasons it is not possible to say too much about it. But the grapevine is still working at 95 per cent efficiency. From it we learn that, despite "bugs" in both men and equipment, the marine power plant equipment turned out in astronomical quantities for our Navy and merchant marine has done a marvelous job. Our present-day stationary practice got ahead of marine steam practice some years back. Then the sailors began to take advantage of the advances in stationary practice. Now the sailors ought to be able to show us some new tricks of their own.

Hard Sciences and soft sciences—do you know what they are? These terms have been used for some time by Gano Dunn, President of J. G. White Engineering Corp. He referred to them in a penetrating discussion of The Engineer's Role in Distribution at the ASME annual meeting in New York last December. A hard science, says Rr. Dunn, is one like physics or mathematics, with which we can predict results with considerable exactitude. A soft science, on the other hand, is one like anthropology or economics which is relatively unable to predict. But our knowledge of the softsciences, says Mr. Dunn, is constantly increasing, rendering them increasingly ready to take their place, with sister sciences that were once soft and have now become hard. Astronomy was once the soft science of astrology and chemistry, today one of the prides of the hard scientists, was once alchemy. These have moved up the scale and psychology has already moved up a long distance. Mr. Dunn believes that sociology and economics are moving up at a rapid rate and that, even now, enough of their factual material has been subjected to orderly classification to enable the application of engineering principles with the expectation of increasingly fruitful results in prediction. As a consequence of this, says Mr. Dunn, as reported in Mechanical Engineering, there is developing the ability to make plans with respect to influencing the "desire to own" to an extent that he believes will successfully bring engineering into the field of distribution, with enhancement of the prestige of engineers, increasing opportunities for their employment, and their usefulness to the community. It is evident, he concludes, that what constitutes an engineer no longer is his occupation, which may run the gamut of the whole range of the hard and soft sciences. What constitutes an engineer is his "way of thinking," which the world is constantly welcoming into new fields.

Underground—More and more we marvel at H. G. Wells. Years ago, in The Shape of Things to Come, he foresaw the necessity for men to go underground with all their equipment to escape bombing planes and rockets. Already, in this war, we are beginning to see that perhaps one of the secrets of Germany's stubborn resistance may be her underground factories—far more of them than we realize.

The British had part of the London subways humming with machine tools; the Germans did the same with the Metro of occupied Paris. We shall soon know how many of the German factories "shattered" by air bombing were really dummies built on top of the real underground plants.

Must the human race, in order to survive from now on, burrow into the ground like moles? Remember the motion picture Metropolis, in which the human race finally revolted against just such a life?

Already tentative designs for hydroelectric plants are beginning to appear with the generating units installed right inside the dam or in tunnels in the surrounding mountains. There is already one underground gas turbine emergency plant in Europe. No one knows how many underground steam installations there may be. (Don't ask if there are any in this country, for we doubt if the military authorities will permit us to tell you.)

Will the very development that gives man his greatest freedom in the sky force him off the surface of the earth in the other direction? We don't think so. It's just a temporary phenomenon, lasting perhaps a few generations at the most. We still have faith that enough human beings have enough intelligence to revolt successfully against such a development.

Franklin Delano Roosevelt

Little that we can say here, can add much to what already has been said about the untimely death of our President, Franklin Delano Roosevelt on April 12, but we do want to express the deep sorrow that the peoples of all the United Nations felt at the passing of our great leader. While it seems ironic that he had to be taken away at a moment when the victory he had worked for long and so sincerely was almost at hand, this, in the end will only add to his greatness. As Mrs. Roosevelt said when she resumed her newspaper column a few days after the President's death, "Perhaps, in his Wisdom, the Almighty is trying to show us that a leader may chart the way, may point to a lasting peace, but that many leaders and many peoples must do the building." It is for us to finish the task to which he so courageously and unstintingly gave himself.

Franklin Roosevelt was a man of many interests and activities. He was deeply concerned with conservation of natural and human resources. The record of his administration includes initiation of such gigantic long range projects as the Tennessee Valley Authority, the Grand Coulee project for the reclamation of desert regions in Washington and the Shasta Development to conserve fertile lands in Central Valley in California. We have followed with intense interest and have given our readers frequent and detailed reports on the engineering developments, problems and implications of these vast government projects which have and will continue to influence power engineering in many phases.

Above all Mr. Roosevelt was human—friendly. Though born wealthy he was for the rank-and-file, he could see the small man's point of view. He smoked cigarettes, he took a drink; he liked a good story, he laughed. He liked kids and flowers and music, and a sailboat; and—he had a dog.

Steam, Compressed Air, and Ref

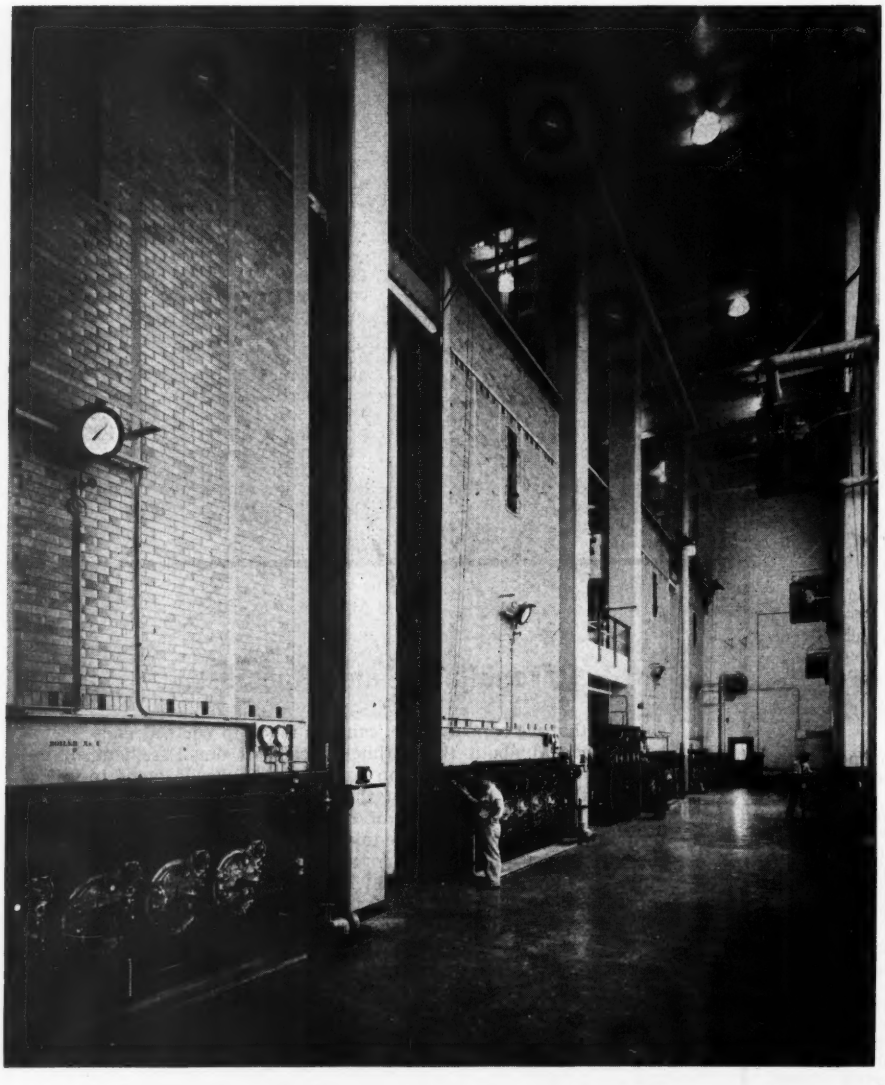


Fig. 1. The four 100,000 lb per hr boilers operate at a saturated steam ressure of 175 psi gage and each unit is fired by five mechanical pressure atomizing oil burners

RECENT LIFTING OF CENSORSHIP, which for reasons of security prevented public disclosure of details of the Pratt & Whitney Engine Plant of United Aircraft Corporation at Kansas City, Missouri, reveals it as one of the largest integrated projects in the entire war construction program.

The plant, built with Defense Plant Corporation funds for final assembly of Pratt & Whitney engines for the United States Navy and designed by Albert Kahn Associated Architects & Engineers, Inc., is more than 1000 ft wide and more than twice as long. All buildings in the project are virtually under one roof, with even the test cells attached to the central structure.

Another indication of the size of the project is that, because of the previously undeveloped site on which it stands, it was possible to provide an employees' parking lot with a capacity of approximately 14,000 cars.

Mechanical equipment for the new boiler and compressor house is naturally on a comparable scale. In the modern reinforced concrete and brick structure shown in the accompanying photographs are housed the steam generating equipment, air compressors, refrigerating machinery and the necessary auxiliaries, all of which are detailed under the sub-headed sections of this paper.

The boiler house is located at the north-west corner of the main building. It is constructed of concrete and brick, with cinder block interior, and with vertical sash 34 ft high in the boiler room and horizontal sash in the compressor room. The two rooms are separated by a cinder block wall.

Steam Generating Equipment

The steam generating equipment consists of four 100,000 lb per hr bent tube boilers of the three drum type, operated at a saturated steam pressure of 175 psi gage.

Each boiler is fired by five mechanical pressure atomizing oil burners of the variable capacity type designed to burn bunker "C" fuel oil.

Each boiler is equipped with forced and induced draft fans direct connected to electric motor and turbine drives. Turbines are designed to oper-

Refrigeration for a Large War Plant

By P. N. Choporis

Mechanical Engineer, Albert Kahn Associated Architects and Engineers, Inc.

This is a description of the boiler and compressor house serving the new Pratt and Whitney Aircraft engine plant at Kansas City, Mo. It is an excellent example of the splendid type of engineering design and construction that has been carried on during the war in so many plants throughout the country. A description of the electrical distribution system at this plant is presented in the article immediately following. All photographs in this and the following article were taken by the Hedrich-Blessing Studio of Chicago and were furnished by Albert Kahn Associated Architects and Engineers, Inc., of Detroit

ate against an exhaust back-pressure of 30 psi when supplied with saturated steam at 165 psi gage pressure.

Two of the boilers are designed to utilize the hot gases from the incinerator which is located at the south end of the boiler house.

The incinerator has a capacity to incinerate 4200 lb of mixed refuse per hour and is equipped with a forced draft fan and a refractory lined air operated guillotine type door.

Fuel Oil Storage and Unloading Facilities

Fuel oil is stored in two concrete rectangular storage tanks having a combined capacity of approximately 500,000 gallons. The tanks are located underground, thereby permitting the use of the area above tanks for parking and landscaping, and also allowing tanks to be filled by gravity in case of failure of the unloading pump.

Fuel oil is unloaded from fill boxes located along a railroad spur designed for handling and unloading as many as six tank cars simultaneously.

Refuse oil from the factory is pumped to an underground refuse oil storage tank located near the main fuel oil tanks.

A separate refuse oil pump and piping system is installed parallel to the bunker "C" fuel oil lines and cross connected in such a manner as to permit the burning of refuse oil under two of the boilers.

Air Compressors

A total of 6 air compressors, having a combined capacity of approximately 12,800 cfm of free air, are installed in the lower level of the compressor room.

Five of the compressors are of the duplex steam driven type, designed for 110 psi air discharge pressure, and operated with saturated steam at 165 psi gage pressure at the throttle. An exhaust steam back-pressure of 30 psi gage is maintained and exhaust steam utilized for various heating applications in the factory and boiler house.

One electric driven air compressor of approximately 1000 cfm free air capacity is installed for off-peak operation and which also serves to assist in the heat balance of the plant. The driving motor is of the synchronous type operating at 4600 v with a 0.8 leading power factor.

Refrigerating Machines

On the upper level of the compressor room are installed the eight centrifugal refrigerating machines which have a combined refrigerating capacity of 7325 tons, and consist of the following units:

3— 800 ton motor driven
1—1000 ton motor driven
1—1200 ton turbine driven non-condensing
1—1200 ton turbine driven condensing
1—1075 ton turbine driven condensing
1— 450 ton turbine driven condensing

All except the two 1200 ton units are used machines which were reconditioned and installed in the new compressor room.

These machines provide the necessary refrigeration for the air processing system which supplies certain vital areas in the factory requiring all-year-round control of temperature and humidity.

Fig. 2. A view looking toward the cooling tower circulating pumps in the boiler house

Fig. 3 (Left). An exterior view of the boiler house showing the cooling tower at the extreme left

Fig. 4 (Below). A view in the boiler house at the rear of boilers Nos. 1 and 2, showing the incinerator duct

During the cooling season, chilled water is circulated from the water coolers of the refrigerating machines to the different supply units located throughout the plant.

During the heating season, hot water heated by exhaust steam from air compressors and other boiler room auxiliaries, is circulated through the same piping system to the air supply units in the plant.

Cooling Tower and Pumps

At a distance of approximately 100 ft away from the boiler and compressor house is located the 25,000 gpm cooling tower which provides the cooling water for the refrigerating condensers, steam condensers and air compressors.

The cooling tower is of the induced draft multiple cell type consisting of twenty-four cells and fans each operated by a 25 hp motor.

Five cooling water circulating pumps, each having a capacity of 5000 gpm at a total head of 100 ft, circulate the cooling water between the cooling tower and the cooling and condensing equipment. Pumps are driven by 150 hp synchronous motors with 0.8 leading power factor and have direct coupled exciters.

Utilization of Exhaust Steam

One of the outstanding features of the plant is the piping arrangement in connection with the utilization of exhaust steam from the boiler room auxiliaries and the steam driven air compressors.

The exhaust steam piping at 30 psi gage pressure from the turbines driving the forced and induced draft fans, boiler feed pumps, hot or chilled water circulating pumps and the five steam driven air compressors, after passing through the oil separator, are connected to a common header. From this header exhaust steam is taken off to supply the feed water heater at 5 psi through a pressure reducing station.

A large portion of the total available exhaust steam at 30 psi is utilized in the hot water converters, during the heating season, for factory and office heating through a forced circulating hot water piping system which is also arranged to circulate chilled water during the summer season for conditioning the vital factory and office areas.

Electric Power Supply

The power supply for the boiler and compressor house is furnished by two 2400 kva, 13,800/2400 v, 3 phase, 60 cycle pyranol filled transformers with adjoining totally enclosed switchboards.

Starting breakers are included in the switchboards for the large motors ranging from 150 hp to 1000 hp and operating on 2400 v. These starters are controlled from remote stations located near the motors.

An additional unit substation for auxiliary power is fed off the 2400 v switchboard. This consists of two 500

Fig. 5 (Right). This is another view in the boiler house looking at the forced draft fans in the basement

Fig. 6 (Left). The refrigerating equipment which has a total refrigerating capacity of 7325 tons is all installed on the upper level of the compressor room. Four of the eight centrifugal refrigerating machines are motor driven, the other four are steam turbine driven

Fig. 7 (Right). The six air compressors which have a total capacity of 12,800 cfm are installed on the lower level of the compressor room. Five of these machines are of the duplex steam driven type, the remaining one being driven by a synchronous motor

kva, 2400/480 v, 60 cycle pyranol filled transformers, one on each end of 480 v switchboard. This unit supplies power to all the 480-v equipment and in addition feeds a 100 kva, 480/120/208 v 60 cycle, dry type transformer for lighting.

Combustion Control and Metering

A complete system of automatic combustion control and metering equipment, consisting of master controller; fuel-air ratio and furnace-draft regulators; steam flow meters for each boiler, and gas temperature recorders, provide the operating personnel with the necessary means and data for safe and efficient plant operation.

Boiler Water and Concentration Control

An internal boiler chemical treatment system, arranged to supply specific quantities of chemicals to each boiler according to the individual requirements of each boiler, maintains the boiler water at the recommended concentration.

A system of continuous boiler blow-off, consisting of heat exchanger, flash tank, sample cooler and controls, also assists in maintaining proper boiler water conditions as well as utilizes the flash steam, from blow-off water, in the feed water heater. The heat exchanger preheats the cold boiler make-up water, utilizing the heat in the blow-off water before being wasted to sewer.

Principal Power Plant Equipment

Boilers	Union Iron Works
Feed Water Heater	Cochrane Corporation
Boiler Feed Pumps	Allis-Chalmers Mfg. Co.
Oil Burners	Todd Combustion Equipment Co.
Induced Draft Fans	Buffalo Forge Co.
Forced Draft Fans	Buffalo Forge Co.
Air Compressors	Ingersoll-Rand Co.
Cooling Tower	J. F. Pritchard & Co.
Oil and Steam Separators	Cochrane Corporation
Combustion Control & Metering	Bailey Meter Co.
Turbines Driving F.D. & I.D. Fans	Worthington Pump & Machinery Corp.
Motors Driving F.D. & I.D. Fans	Westinghouse Electric Mfg. Co.
Boiler Water Conditioning	Permutit Co.
Expansion Joints	American District Steam Co.
Cooling Tower Circulating Pumps	Allis-Chalmers Mfg. Co.
Heating & Cooling Water Circulating Pumps	Allis-Chalmers Mfg. Co.
Power Transformers & Switchboards	General Electric Co.
Refrigerating Machines	Carrier Corporation Worthington Pump & Mach. Corp. York Corporation

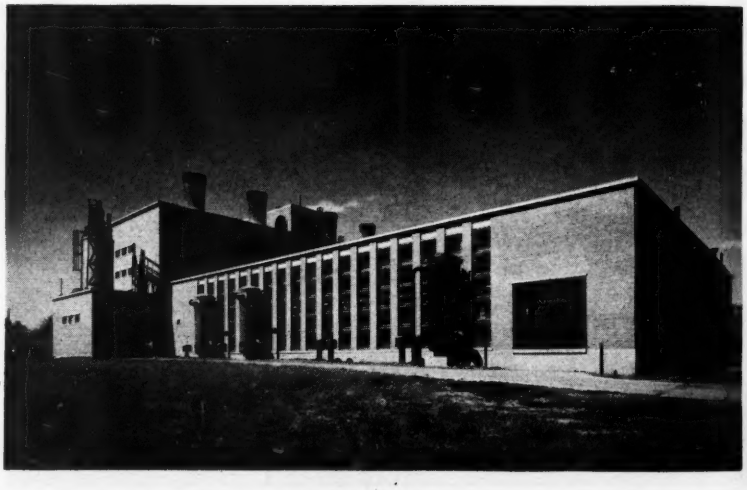


Fig. 8. A view taken at the rear of the plant showing the compressor room

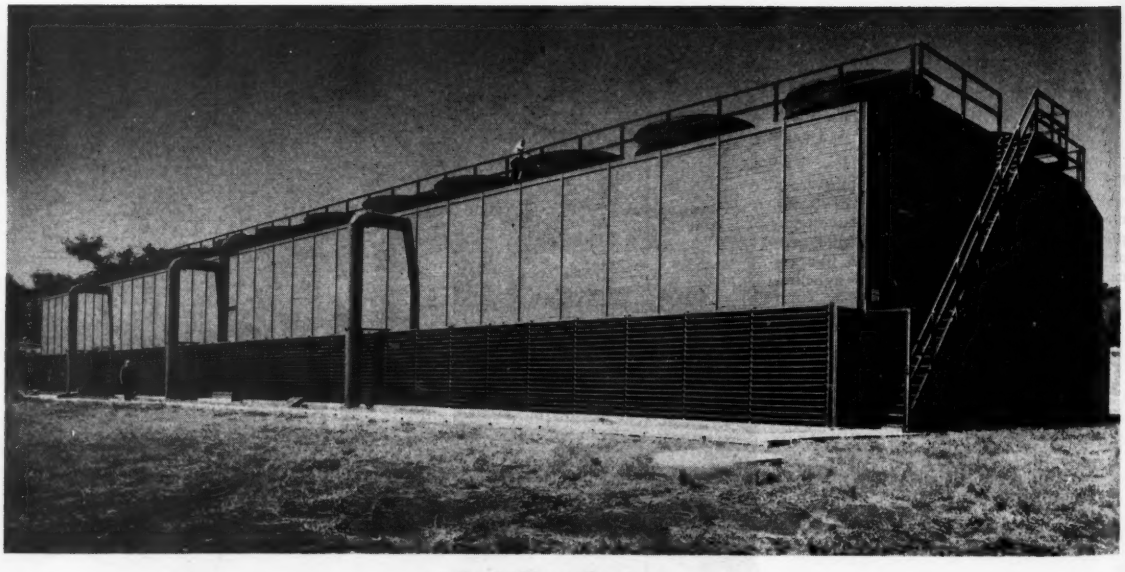


Fig. 9. The cooling tower

Electrical Distribution System of the Pratt & Whitney Plant

This article which is an abstract of a paper presented at the winter meeting of the AIEE in New York describes the features of the electrical distribution system of the Kansas City plant of the Pratt & Whitney Aircraft Corporation, the boiler plant and air compressor room of which is described in the preceding article. The entire electrical distribution system at this plant was negotiated as a single project. The co-operative efforts of the Pratt & Whitney Aircraft Corp.; the Albert Kahn organization; the General Electric Co.; together with the Defense Corp., were enlisted to that end. This description therefore is more than a description of the distribution system at the Pratt & Whitney plant—it is a description of principles and practices which can be adopted with equal success in other plants.

By R. H. Kaufmann, Industrial Engineering Div., General Electric Co.

and N. A. Kieb, Electrical Engineer, Pratt & Whitney Aircraft Corp. of Mo.

A BIRD'S EYE view of the complete distribution system is presented by the over-all one-line diagram, Fig. 1. In immediate evidence is the application of the load-center principle of power distribution, "Transmit power at the highest practical voltage to relatively small distributed substations." In this instance, primary distribution is accomplished at 13.8-kv.

Reliability of electric service is incorporated in the form of the secondary selective arrangement in which each individual load-circuit has access to an alternate independent source of low tension power. This system has met its expectations with flying colors, possessing the following outstanding advantages:

1. Both normal and emergency operation incorporates the simplicity of radial distribution.

2. All circuit equipment normally shares in carrying the total load resulting in low power and reactive kva loss, as well as better maintained delivered voltages.

3. Emergency operation entails merely the opening of the low-tension circuit breaker in the de-energized source and closing the tie breaker.

It will be observed that effective duplication of electric service is carried through to the incoming 110-kv supply system. The two coordinating primary feeders at each and every substation originate from different 13.8-kv buses. Both of the latter in turn may be energized by either or both main transformers and (should a second 115-kv feeder be added) from either or both incoming high-tension lines.

Main Factory Building

The main factory building encloses under a single roof a ground area of 1000-ft by 2000-ft. Operations are conducted on a single floor at ground level, with the exception of a mezzanine floor over about 10 percent of the area, making a total working floor space of about two and a quarter million square feet. Of this total area, approximately 70 percent is devoted to active manufacture, 15 percent to rough stores, 10 percent to finished parts receiving, assembly and shipping, and 5 percent to inspection. The mezzanine floor is allocated to inspection and a portion of the active manufacture.

Supplying general purpose power and light to this area are sixteen load-center unit substations aggregating 30,000-kva, representing about 13.3 volt-ampere per square foot of working floor space. In one load area, an additional load-center substation has been installed because of a high concentration of power in the form of heat-treating equipment. In general, the area served by a single substation is about 250-ft by 500-ft, but is somewhat larger in areas characterized by lower power utilization densities. In the rough stores area, the supply substation capacity is reduced by the application of 750-kva transformer units, in contract with 1000-kva units used elsewhere.

The substations are installed in enclosures forming a part of ventilating fan houses located on the building roof. The reasons for this selection are: 13.8-kv feeder cables are supported on racks close to the building roof; the bulk of the power is distributed to plug-in bus also located closer to the roof than to the floor; and the fact that the enclosures could be integrated with houses there located for other purposes.

Both power and light are served by common load-center unit substations using a 406/265, 4-wire, grounded neutral system to supply 440-v polyphase motors in the normal manner and 265-v fluorescent lighting units from line to neutral potential. Plug-in bus is used to distribute power to the major portion of the load consisting of distributed machine tools so as to obtain the needed flexibility to accept fairly frequent rearrangement of machine tools for production efficiency improvement or changed requirements.

Factory Power Distribution

The manner in which low-voltage power is distributed from the load-center unit substations to the plug-in bus sections for a typical unit load area is illustrated in Fig. 2. Two adjacent 230-ft lengths of 250-Amp. WPB approved plug-in bus are fed from their center point by an individual power feeder from the substation. To avoid operation at undue temperature on the plug-in bus, should the load be badly disproportioned among the four radial extensions, a temperature alarm (including bell and lamp) is installed adjacent to the feeder tap on each bus section which will sound an alarm upon reaching an 80 C operating temperature. Each power feeder consists of three single-line conductors plus one bare neutral conductor, which conductors are symmetrically spaced by means of trisected porcelain support blocks. Individual conductors are kept taut by

straining them in the horizontal direction to structural members of the building.

Factory Lighting Distribution

Fluorescent lighting was adopted in the interest of economy. On first thought, the copper and steel in fluorescent ballasts might indicate that incandescent lighting would have the advantage. On the other hand, the greater light efficiency of fluorescent lamps reduces the power requirement of the factory area by some 6000 to 7000-kw. The copper and steel which would be required in the complete electrical system, from prime mover to lamp, to supply this additional load would exceed the copper and steel needed in the fluorescent lamp ballasts. The material requirement of the 265-v design are much less than for the 120 or 208-v design. Also the supply of both light and power from common load-center unit substations results in further economy of materials. An ingenious innovation is represented by the suspension of a series of fluorescent units from an overhead messenger cable. A single No. 12 conductor, in combination with the messenger as a ground return, serves a 4-kw lighting load.

A sketch showing the fundamental aspects of factory lighting distribution is included in Fig. 2. Ten 400-watt fluorescent fixtures are supported from one overhead horizontal messenger cable. Each fluorescent fixture taps the No. 12 feeder line carried horizontally directly below the messenger through the fuse. Three such adjacent strings of fluorescent lights are fed from a three phase tap from the main lighting feeder through circuit-breakers located in a building column five feet above floor level.

To supply a relatively small amount of 120-v power to column receptacles for miscellaneous handtools, portable lights, etc. and for lighting and receptacle power in basement washrooms, small air-cooled transformers are distributed over the factory area, taking single-phase power from the 480-v system and converting it to 240/120-v. This power is distributed by branch circuits of relatively short length.

Capacitor Application

About 10,000-kva in capacitors have been applied to the 480-v distribution system, in 90-kva blocks directly adjacent to the feeder tap in the plug-in bus. The principal reason for the capacitive kva is a power-contract power-factor clause limiting the PF to not less than 0.975 lagging. By absorbing the reactive kva near its origin (machine tool load), the reactive kva and power loss which would be incurred by transmission through the distribution system is avoided.

Capacitor application constitutes an extremely flexible means of enhancing the load carrying ability of a particular load-center unit substation.

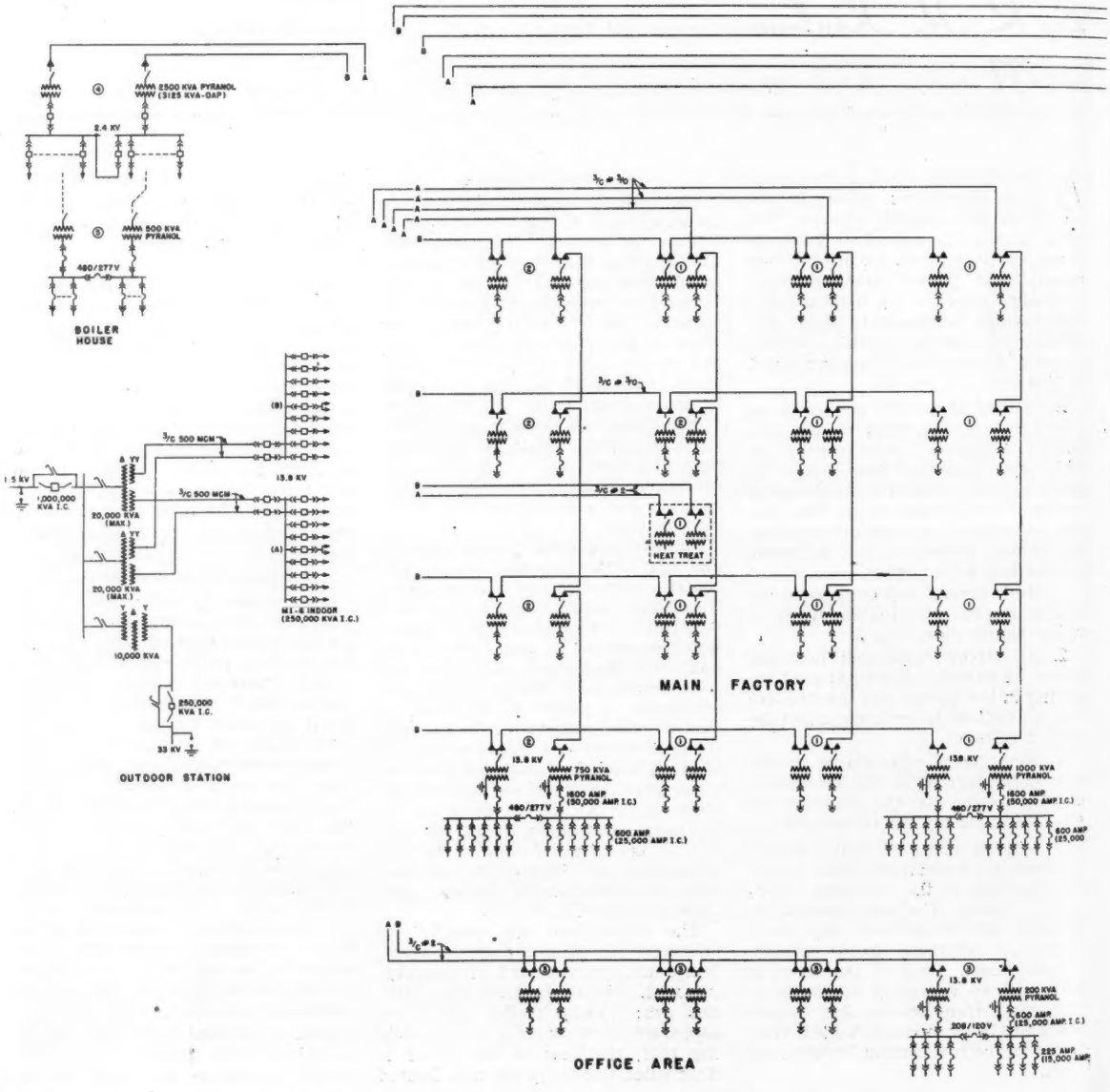


Fig. 5 defines the increase in load which may be accepted in combination with a particular amount of capacitor kva, for a basic load power factor of 0.6 and 0.8 lagging. With a load power factor of 0.6 lagging (typical of machine tool load), it will be observed that the amount of such load which can be accepted by a 1000-kva substation without exceeding its rating can be increased to 1300-kva by the application of 420-kva in capacitors. *Thus an excess machine-tool load of 300 kva could be accepted, as needed at an investment cost of $11 per kva (420 kva of capacitors at $8 per kva installed) which is no greater than the cost of increased capacity in the basic power distribution system.*

Grounding System

Considerable study was given to the attainment of an adequate grounding system, which assumes particular significance in reinforced-concrete building construction. The unintentional transfer of ground current between various metallic members or structures is to be avoided. It is particularly important that there exist a positive direct path to the supply transformer neutral to conduct ground fault current during the existence of a circuit ground fault to avoid sputtering or arcing between metallic members which may be in light contact and to avoid differences of potential between exposed metallic bodies which might constitute a hazard to personnel.

Beneath each substation are driven four ¾-in. diameter, 10-ft long Copperweld ground rods interconnected with the associated substation neutral bus. At each station these are bonded to heavy water mains, which in general traverse the plant in the north-south direction. Between adjacent unit load areas in the east-west direction, the 4/0 neutral cable of the outermost power feeder is continued and joined to the corresponding neutral in the next adjacent load area, and the lighting messenger cables are electrically interconnected from one load area to the next. This entire grounding system is interconnected with the main substation grounding system by way of the main water piping system and the metallic sheaths of the multiplicity of power feeder cables.

Office Building

The office building covers an area of 80-ft by 2000-ft, is served by four load-center unit substations of secondary selective design, functionally equivalent to those located in the factory, differing in that the low-tension service is 208/120 v and individual pyranol transformers are rated 200-kva. The aggregate substation capacity of 1600-kva can accommodate an electrical load density of 2-volt-amperes per square foot in the basement area and 4-volt-amperes per square foot on the first and second floor. (Lighting on the first and second floors accounts for between 2 and 3 volt-amperes per square foot.)

These substations are located in houses (wood construction) on the factory roof directly adjacent to the office building. The tow-tension feeders from each substation, drop through the factory roof, and are then carried horizontally using the same type of construction as is used for factory feeders. At appropriate points, branch circuits are carried through the wall to the office building and dropped vertically in conduit to supply distribution cabinets at the second, first, and basement floor levels. The detail arrangement of this low-tension feeder system is portrayed schematically by the sketch, Fig. 6.

Engine Test and Dynamometer Area

This section of the plant is devoted to production and experimental engine testing and occupies an area of 250 by 900 ft. Each production test cell requires a 250-hp blower motor together with several small motors driving fans and pumps, and special interior lighting of explosion-proof character. There are associated areas requiring illumination equivalent to that provided in the factory area with relatively low power load density. That portion devoted to experimental engine test involves electrical power requirements similar to those of the production test area, but in addition incorporates electrical test dynamometer equipment of which the present equipment utilizes 2- 1250-kva and 1- 750-kva synchronous rotating machines. There are also a number of motors of 300 and 600 hp rating.

Serving this load area are three unit substations converting from 13.8 to 2.4 kv, using the secondary selective principle incorporating individual transformers of 2500-kva normal rating (3125-kva with supplementary cooling) in combination with metal-clad, vertical lift, switchgear sections utilizing Magne-blast circuit breakers of 50,000-kva interrupting capacity. The two complementary sections of the substation are installed face to face. The tie breaker is installed in one lineup and the bus from the other section is extended by means of 500,000 cir mils, 3-conductor, 5-kv cable.

The stator circuit of each 2300-v machine is directly connected with its respective switching position in the metal-clad lineup by means of 3-conductor, 5-kv cable. In general, the normal control of each motor circuit breaker is from a control panel adjacent to the controlled machine. The metal-clad circuit breaker position contains a permissive control switch allows the circuit-breaker to be tripped locally and can be positioned to prevent closing the breaker from the remote station.

Small motors and general purpose lighting are served by load-center unit substations supplying 460/265 v service, which closely resemble those employed in the factory area except that they are of smaller rating and are served at 2.4-kv from the main stations.

Boiler House Area

The electrical load demands in the boiler house closely resemble those of the engine test and dynamometer area. A substantial number of motors with ratings in excess of 100 hp are employed, which were most effectively served at 2.4-kv. In addition, there exists the usual array of boiler house small auxiliaries in the form of fans, blowers, and pumps, which are best adapted to low-voltage service.

Serving this load is one secondary selective substation converting from

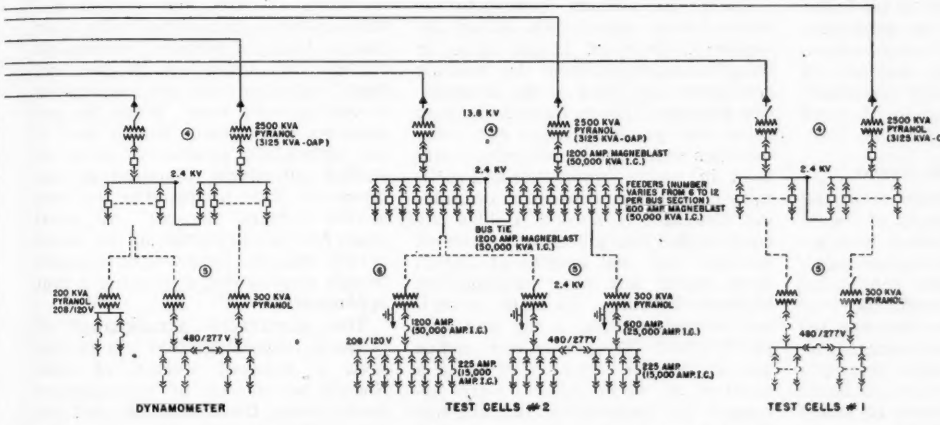

2500 KVA PYRANOL (3125 KVA-OAP)
2.4 KV
200 KVA PYRANOL 208/120V
300 KVA PYRANOL
480/277 V
DYNAMOMETER
13.8 KV
2500 KVA PYRANOL (3125 KVA-OAP)
1200 AMP MAGNEBLAST (50,000 KVA I.C.)
FEEDERS (NUMBER VARIES FROM 6 TO 12 PER BUS SECTION) 600 AMP MAGNEBLAST (50,000 KVA I.C.)
BUS TIE 1200 AMP MAGNEBLAST (50,000 KVA I.C.)
1200 AMP (50,000 AMP I.C.)
600 AMP (25,000 AMP I.C.)
208/120 V
225 AMP (15,000 AMP I.C.)
TEST CELLS #2
TEST CELLS #1

Fig. 1 (On this and opposite page.) Single line diagram of the electrical distribution system. The several component parts as shown on this drawing represent, approximately, the geographical arrangement

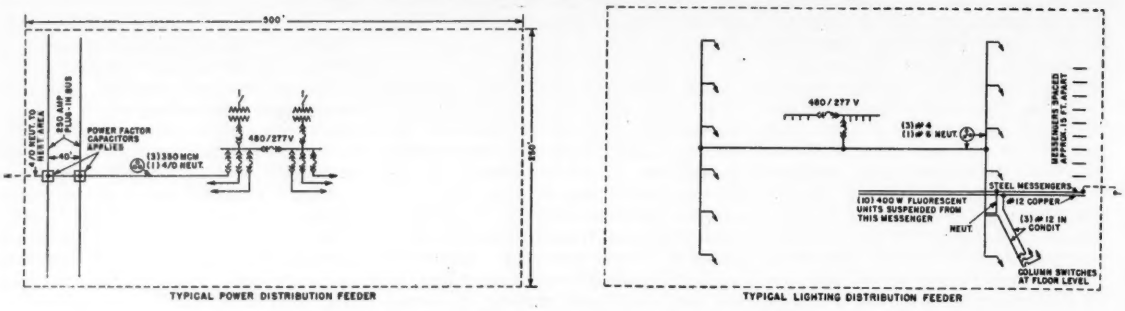


Fig. 2. Low-voltage distribution pattern for factory substations

13.8-kv to 2.4-kv with component parts duplicating those employed in the test area substations. Low-voltage power is supplied by a load-center unit substation delivering 460/265 v service in the same manner as was done in the test area.

The electrical demands in the boiler house area are at their maximum level during the summer months when the refrigerating plant assumes its maximum demand. During that season the substation is loaded to its rated capacity.

13.8-Kv Feeder Cable System

All power is distributed from the main substation by means of 3-conductor, 15-kv, leaded cables, with asbestos tape and red flameproof paint. The majority of feeder cables are composed of No. 3/0 conductor, representing an economical balance between copper and sheath metal requirements. Several cables employ a No. 2 conductor which represent about the smallest size which can be safely employed with a 250,000-kva short-circuit level at the source end. Instantaneous attachments on these feeder-cable protective relays are applied and required to avoid the attainment of damaging copper temperature due to primary-circuit fault-current flow.

Except for circuits leading to the boiler house, the 13.8-kv cables are supported on wood lattice racks or troughs suspended from the building roof above the level of the illumination fixtures. This method of handling cable runs possesses many admirable qualities which can be advantageously used in future applications. Practically no advance preparation of building structure is needed. Cables are easily pulled into place. In the present instance, full reel lengths of 1000-ft were pulled into place without the slightest difficulty. To assist in pulling around corners, a jig was prepared which forms a 24-inch radius arc, around the periphery of which a number of wood rollers were arranged. By temporarily clamping this jig at a corner, the cable was swung around a 90-degree turn with a very small amount of drag. Splices can be made at any spot along the trough. Cables are cut only when a point of termination is reached. The entire length of cable is accessible after installation. Repairs can be made with no waste of cable and without disturbing any section of the cable other than a damaged portion. Permissible current load levels are no less and may be greater than those permitted in underground runs. While the appearance of the cable trench itself is not particularly pleasant, it is, as installed, effectively obscured by the blanket of light produced at the level of the lighting fixtures. As metal again becomes available, its use would permit efficient, light-weight, compact trough construction possessing a neat appearance.

The quadrature arrangement of primary feeders used in the factory area is believed worthy of note. Should an outage of one primary feeder occur, the several affected stations will each derive their emergency load from different primary feeders. Thus the emergency load resulting from the loss of one primary feeder is distributed among four other feeders. It will also be evident that the two feeder cables to any one substation traverse entirely different routes and are thus unlikely to be simultaneously disrupted.

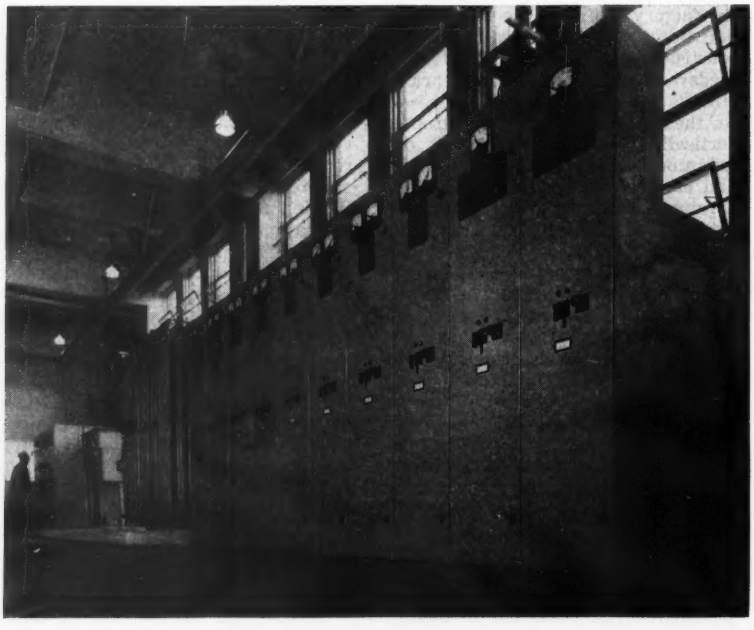


Fig. 3. Boiler house switchboards

Main Incoming Power Substations

Space does not permit, here, the complete description of the main incoming power substations contained in the original paper presented before the AIEE,[1] but a few facts may be of interest. The incoming power substation accepts power at 110-kv, converts to and distributes at 13.8-kv, to the various unit substations previously described. Provision is included for interconnection with 33-kv service.

Outdoor equipment includes two 20,000-kva forced oil, air pressure cooled transformers; one 10,000-kva oil immersed self-cooled transformer; one 115-kv oil circuit breaker; one 33-kv oil circuit breaker and three 115-kv transformer high-tension dis-

[1] Modern Electric Power Distribution Ideas as Applied in a Large War Plant. AIEE Technical Paper 45-79, January, 1945.

connect switches and horn gap. The substation structure is of wood.

Indoor equipment consists of two metal-clad switchgear assemblies of the vertical lift type with 250,000-kva interrupting capacity and one duplex control board, control power battery, battery charging equipment and distribution panel.

Relaying

All 13.8-kv feeder units are individually equipped with inverse-time overcurrent line and ground trip relays, the former coordinated to be selective with unit substation switching equipment. Instantaneous attachments, set above the current level obtained with a unit substation low-tension bus fault, are also applied to avoid damaging internal temperature on the No. 2 conductor feeder cables, by shortening the clearing time in the presence of high fault current magnitudes.

The 13.8-kv incoming power circuits are individually equipped with inverse-time overcurrent line and ground relays coordinated to be selective with feeder circuit line and ground relay protection.

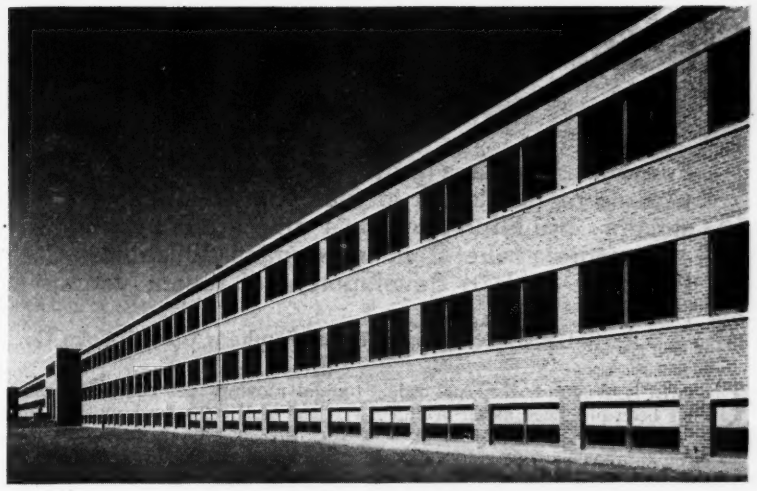


Fig. 4. View of office and manufacturing plant

The 33-kv incoming line circuit is equipped with inverse-time overcurrent line and ground relays, together with power directional relays, selectively coordinated with remotely located 33 kv protective equipment.

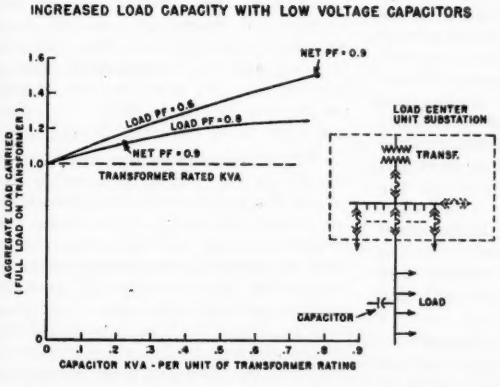


Fig. 5. Chart showing increased machine-tool load permissible with capacitor assistance

Transformer differential relay protection is applied to each of the 20,000-kva and the auxiliary 10,000-kva transformers. While the absence of individual high-tension circuit breakers requires that the entire system be de-energized, the differential protective relays minimize internal damage by promptly interrupting the source of power and, by relay targets, identifies the unit in trouble, enabling it to be immediately isolated and service promptly restored on remaining equipment.

The 110-kv incoming line circuit is provided with inverse-time overcurrent line and ground relays, the former selectively coordinated with 13.8-kv switching equipment and the latter coordinated with ground relaying at the source end of the line. Power directional relays directed outward are applied to obtain automatic opening of the 110-kv oil circuit breaker as a result of external trouble on the 110-kv line.

Summary

The operating experience with this electrical system has been remarkably good. Some trouble was initially encountered in the 13.8-kv cable terminal potheads requiring that the circuits be successively de-energized, the potheads opened, and modifications made. The advantages of the secondary network became clearly evident during this procedure. The necessary modification work was carried out without loss of power at any station and without the use of auxiliary make-shift power supply equipment. A number of faults have occurred in the plug-in bus resulting from the accidental insertion of wire or small diameter rod through the expanded metal side barriers.

It may be concluded, without reservation, that the application of load-center distribution principles as described was responsible for an amazing reduction in material investment, principally copper and steel, compared with that which would be required by power distribution methods currently employed only a short time ago. In planning the project the greatest emphasis was constantly placed on conservation of materials.

It is the sincere hope of the authors that some of the features which have proved so beneficial in this installation, may in some small measure assist others to realize an improved more economical industrial distribution system in the future.

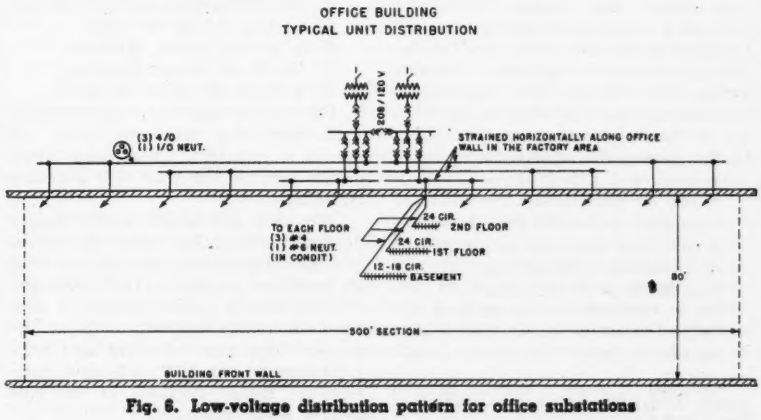


Fig. 6. Low-voltage distribution pattern for office substations

Underfeed Stoker Fuel Beds*

Furnace conditions that govern temperatures—Causes of resistance to fuel flow in underfeed stokers—Handling hot spots and rapid burning—Immediate relief from segregation difficulties—Prepared coals a development of recent years

By L. A. SHIPMAN Fuel Engineer, Southern Coal & Coke Co.

COMBUSTION of coal in fuel beds has been practiced as an art for many years; during the last 27 yr a scientific approach to this subject has contributed a small amount of fundamental data. The subject is very controversial. The performance of the same coal used in the same equipment in different plants may result in opinions varying from the best coal ever used in the plant to the worst coal ever fired. These opinions can both be true due to the varying conditions under which the coal was used.

In boiler furnaces fired with underfeed stokers, we can do several things to vary conditions in the furnace or fuel bed.

Furnace temperatures can be increased if desirable by increasing the amount of refractories, by designing baffles or operating dampers so that a near balanced or balanced draft exists over the fire. Fuel bed temperatures can be increased by increasing burning rates. A given furnace has its temperature limited by the steam to be produced, the melting of refractories, and by the clinkering of the coal. Fuel bed temperatures are limited by the clinkering of the coal ash and the melting of the stoker iron.

Hence, it is obvious that too high temperature in a furnace and fuel bed is not desirable. We can vary the rate of heating of the coal coming up out of the retort in a multiple retort underfeed stoker operating at a given temperature by increasing or decreasing the longitudinal motion of the coal down the retort. Increasing the coal movement down the retort results in relatively thin rapidly moving fuel beds and wide burning lanes. Decreasing the longitudinal movement down the tuyeres increases the vertical movement and results in thicker fuel beds and in extreme cases very narrow burning lanes.

When we increase the movement of a given coal down the retort we expose that coal faster to the temperatures existing, depending on the width, depth and the angle of the retort in relation to the angle of the tuyeres. Deep retorts, all other things being equal, result in slower longitudinal moving fuel beds, increasing vertical and cross feed motion, and with the so-called coking coals, stronger coke formation.

These deep retorts are not desirable when the ash content and fusion temperature is such that so much burning takes place in the underfeed section as to block it with ashes and clinkers. They are desirable with fairly low ash, medium fusion, "non-coking" coals. The shallow retorts offer more flexibility with strongly coking coals and with the high ash low fusion coals.

The travel of coal in an underfeed stoker varies as the resistance to the longitudinal movement of the coal varies. I have been told by exceptionally well informed engineers that this resistance occurs only in the front of the stoker where the coal is initially fed. While this is generally true, because most of the increase in resistance can occur at the front of the stoker, nevertheless it is a fact that as the resistance to the longitudinal flow of coal increases anywhere in the retort, the more of a vertical and lateral movement of the fuel will take place at that point.

Causes of Increased Resistance

Items which will increase the resistance to the longitudinal flow of coal down the retort and increase the thickness of the fuel bed by increasing the vertical and lateral flow are:

1. Bulk density of coal increase.
2. Depth of retort increase.
3. Shortening secondary ram stroke.
4. Shorten extension grate stroke.
5. Strong coking of coal.
6. Slope of retort decrease.
7. Width of retort increase.
8. Length of retort increase.
9. Oxygen concentration decrease.
10. Reducing ash discharge on dumps or grinders. These same items in the reverse extreme will decrease resistance.

One idea for which every stoker designer and stoker operator strives is even burning over the fuel bed with its resultant maximum fuel consumption at lowest gas velocities in contrast to spotty burning with its resultant high gas velocities and temperatures in the hot spots and inactive or "dead" portions of the fuel bed in other places.

Coking, Caking and Matting

Two causes of uneven burning with its resultant hot spots predominate. The first is caking and matting and I think it most important because it can be the cause of the second. The second is clinkering which though it can be caused by caking and matting, it can also be caused by operation or by the characteristics of the ash itself being unsuited to the burning condition prevalent.

Coking, caking or matting of a fuel in the fuel bed is the coal "characteristic" which has the greatest effect on performance where coal is processed and the resultant coke fed and burned over the tuyeres of an underfeed stoker. What chemical and physical conditions exist which increase or decrease coking, caking or matting, and how they can be controlled or changed, will require the best effort and co-operation of research laboratories, coke experts and fuel engineers.

A fireman handling a stoker is interested in operation more than fundamentals. When caking or matting exists to the extent that trouble is experienced the resistance to the longitudinal flow of coal is at or near its maximum. The burning lanes are narrow and irregular; some of them completely matted over; the fuel bed is deep and the longitudinal movement of the fuel down the retort and the tuyeres relatively slow. Hot spots and high rapid burning are noted.

To help this situation the fireman should do everything he can to decrease the resistance to fuel flow down the retort. Starting at the dump the fireman should decrease this resistance by dumping, increasing stroke of continuous ash discharge or speed of clinker grinder whichever the case may be. Next he should increase the stroke of over feed section grates to push the fuel bed down on the dumps and decrease resistance to secondary pushers on the underfeed section, then he should increase the stroke of secondaries to increase longitudinal flow of fuel down the retort and reduce the resistance against the coal pushed in by the primary ram. This procedure in most cases will thin down the fuel bed, increase the width of burning lanes, slow down gas velocities in the underfeed section and, while maintaining the over-all burning rate, reduce the maximum burning rate by increasing the active area.

Segregation of Fuel Sizes

In addition, the fireman can at times, if segregation of sizes has aggravated the trouble, locate some coarser coal whose bulk density is less and start it in the hopper. In some cases he must adjust the various air dampers to assist in this new burning condition which moves the fuel faster down the retort to the dumps, otherwise coke would be discharged with the ashes.

*Abstract of paper presented at joint ASME, AIME Fuel Meeting at Charleston, West Virginia.

Depth of the retort is constant with the stoker as installed. Increasing the depth of the retort slows the movement of fuel down the retort, all other things being equal. If it is desirable to cause an increased fuel bed thickness when burning a high ash coal, especially one of low ash fusion temperature, special care should be taken that the retort depth is not too deep nor the retort too long so that the fuel is moved down the retort so slowly that ashes and clinkers build up on tuyeres and over retorts and interfere with carrying boiler ratings.

The width of the retort and the angle of bottom and top of retort are also part of stoker design and while all is not known of the effect of these items, I do feel that varying these in such a way as to influence temperature and time of coking will have definite effects on coke structure of a given coal under controlled burning conditions.

One of the newer tools used by the fuel engineer of the last six or seven years is controlled manufacture at the mines of size consist on steam coal. This control method helps in segregation, distribution, coking, speed of burning, coke sizes and structure and bulk density problems and is one of the most important developments in the past decade in proper fuel selection in underfeed fuel beds.

Schadenlust

THE GERMANS have a word for it—*Schadenlust*. It may be translated as "a lust to create damage and to destroy." There is no equivalent in English or Italian. It requires this German word to describe the destruction of power plants, bridges and other public works in Italy. Not only has the destruction of works which were of military value been complete, but the damage to property often has been such as to suggest that the havoc was wrought to spite the Italians, more than to hinder the Allied armies which were coming in.

Despite this wholesale and methodical demolition, progress has been made in getting some semblance of order out of almost unbelievable chaos, and in getting essential public utilities back into operating condition. This is pointed out in a report of the Allied Commission on public works in 1944.

The report makes it clear that only a start has been made; the job yet to be done is enormous.

For instance, by the end of 1944 the electric utility industry, under the direction and help of the Public Works and Utilities Sub-Commission of the Allied Commission, was able to triple effective generating capacity of electric power plants in central Italy as compared with conditions a few months earlier when Allied troops first liberated the area. By the year-end capacity had been brought up to 170,000 kw, as compared with 57,000 kw less than six months previously.

The sub-commission estimates that generating capacity will be further increased to 342,000 kw by June 30 of this year. Even so, it will then be only about one-third what it was in pre-war days when capacity was approximately one million kw for this region, which extends north from Naples to Florence.

Germans Took All the Copper Wire

In addition to this from July to December of last year about 2000 km of electric transmission lines were reconstructed, all copper wire had been taken away and many towers were either destroyed or badly damaged. The scope of this undertaking alone speaks for itself.

Increased efficiency of existing operating facilities has been obtained by the inauguration in January of this year of a unified or central grid system, by which the generation and transmission facilities of the different power companies in the central Italy area have been brought together to form a single power pool. As a result of this, available power is provided without frequent interruptions which occurred during individual shutdowns before the plants were tied into the system. Extreme voltage variations have been eliminated. Electric frequencies have been standardized at 45 cycles as against widely different ranges which existed formerly and which had caused no end of difficulties. Current consumption is now under centralized control, with the result that military and essential industries have more power available. It is estimated that industrial production has accordingly been increased by approximately 20 per cent.

Few countries, Switzerland being a notable exception, have developed hydro-electric power generation to such an extent as in Italy. Such a development was natural, because Italy is woefully short of other natural resources such as coal, oil and gas, and has had to lean heavily on its water-power. The entire economy is geared to water-generated power, a fact which was well recognized by the Germans. On departing they destroyed, damaged and/or mined for later demolition practically all power plants, transmission lines and water sources, and as a consequence, factories, railroads and food processing plants were unable to operate, which has caused widespread unemployment and privation.

Many difficulties, some almost insurmountable, have confronted the Public Works Sub-Commission and the Italian government agencies and companies. At the time of liberation, engineering officers of the Allied Commission found Italian government agencies disorganized, with many of their best technicians missing, for one reason or another, and the agencies were unable to undertake the work of clearing away the debris and get on with some degree of reconstruction. Of late, however, a real degree of understanding and cooperation has been established, although the Italian Government is still short of technical staff.

Aid to the Utilities

Utility companies themselves were in a paralyzed condition when the Allies arrived. Their technicians were well trained and on the whole the companies were well organized administratively. But inadequate transport and difficulties in getting new electrical equipment or repairs of damaged—and often completely destroyed—machines required the greatest effort to get power generation started again.

Further, the financial position of most of the companies was seriously impaired. Receipts were low because of stoppage of industries, damage to consumers' houses and because many customers had departed for other areas. The electrical companies made many applications for permission to increase their charges, varying from 100 to 500 per cent of pre-war scales. No changes in basic rates, however, were permitted, but relief was provided by allowing some of the more sorely-pressed companies to apply a flat surcharge to the total amount of bills. This was done only after an analysis of profit and loss statements for recent periods showed a company to be operating at a cash loss. The increased charges, where granted, ranged from 75 to 200 per cent.

In order that basic domestic needs could be met, as well as those of the military, a severe rationing system was put into effect in the portion of Italy south of Naples in Feb., 1944.

Cooperation with and training of Italian personnel so that a greater measure of control and planning can be continuously and more rapidly turned over to the Italians will be furthered through boards which have just been formed by the Sub-Commission. They are known as Advisory Committees on Electric Power.

Rehabilitation of the electric utilities of Liberated Italy is only beginning, the Sub-Commission points out. Much of the equipment damaged or destroyed in Central and Southern Italy was manufactured in German-occupied territory or in Switzerland. Much of the equipment to replace that damaged is being sought from the United States. Military requisitions have been placed in the U. S. and some electrical equipment is scheduled to arrive in Italy in the near future.

To sum up, the basic fact remains that — despite power available from what is already operating, from what can be made to operate by cannibalization of damaged plants still out of commission and from electrical equipment supplies from the United States —power requirements in Italy cannot be adequately met for a long time to come, except on a sub-standard basis.

What the Power Engineer Needs to Know About

CHEMICAL FEED SYSTEMS for Water Treatment

By Robert T. Sheen *Associate Director, Consulting Division, W. H. & L. D. Betz*

How chemical feed systems are applied, how they operate . . . Volumetric, gravimetric, decanting feeders; controlled volume pumps . . . Materials of construction . . . Proportional feed systems; electronic system . . . Sodium sulfite and internal treatment . . . Typical plant layout.

THE AUTHOR

ROBERT T. SHEEN has been associated with W. H. & L. D. Betz for over 13 years. His wide experience in the field of water treatment and industrial waste disposal gives him a broad background in chemical feed methods. He was responsible for the design of the large water softening plants at Wright Aeronautical Corp., Cincinnati, Ohio. (See Power Plant Engineering, July, 1944, page 34; August, 1944, page 74); at Geneva Steel Co., South Salt Lake City, Utah, (Ibid, July, 1944, page 75); five water treatment plants for Republic Steel Corp.; and, for other war industries, treatment plants for continuous processing of millions of gallons of water a day. Mr. Sheen is also consulting engineer for Milton Roy Pumps. He has drawn on this combined experience for the material presented here.

IN MOST CASES, chemical feed systems in a power plant are used for treating boiler feedwater. External treatment is frequently required for the removal of turbidity and suspended matter or for the removal or reduction of hardness by softening. The removal or reduction of other dissolved solids is possible by external treatment. Excess acidity or alkalinity may be externally controlled by chemical treatment. Even in power plants where external treatment of some form is not used, treatment of the water for protection of the feed lines and boilers is usually required. Even external treatment alone is seldom the complete answer and some internal treatment is usually indicated.

Chemical feed systems for treatment of the water in the feed lines and boilers are usually of two types. One type is for introduction of sodium sulfite to the boiler feedwater following the open or deaerating type heater. The second type is for other feedwater treating chemicals such as phosphates, caustic, or soda ash, which should be introduced directly at the boiler drum and not through the feedwater lines.

Cooling and Circulating Waters—In most power plants considerable quantities of water are used in circulating systems and in cooling water systems. Such systems frequently require chemical treatment for prevention of scale, corrosion, or biological growths such as slime or algae.

Batch vs. Continuous Processes

A number of years ago, when the necessity for water treatment was first recognized, the first systems of treatment employed were treatments by batch process; that is, by filling a tank with water to be treated, adding the necessary chemicals, stirring for a while, and permitting to settle; then passing the water through filters before being used. Such batch treatment tanks would obviously not require accurate chemical feed devices, as the chemicals would likewise be added by batch. Batch treatment is wasteful of chemicals, requiring excessive quantities to obtain the desired results because of inefficiency of mixing in such a system. The space requirement is considerably above that required for continuous systems of treatment, and batch systems are not installed in plants of appreciable size today.

With the coming of continuous treatment, however, methods for control of the results were required. In fact, the success of continuous treatment is to a large degree dependent upon the accuracy of the control possible on the continuous treatment. The control can only be as accurate as the method of chemical feed. Two variables commonly regulate the feed of chemicals in continuous treatment on water treatment systems; namely, rate of flow and pH value. Rate of flow is the most common, therefore the most important, variable to be considered.

Methods of Chemical Feed

Chemical feeders may be classified by the form in which they handle the chemical—that is, either in the solid dry form by dry feeders or in liquid form by wet feeders.

Dry feeders are normally indicated where larger amounts of chemical are to be handled each day, although on certain chemicals, such as alum, soda ash, and lime, they may be operated satisfactorily at rates as low as 20 lb per hr or less. Solution feeders are usually preferred for the lower rates of feed. The type of chemical to be fed will usually further indicate the best type of feeder; for example, ferric sulfate and ferric chloride are best handled in solution feeders in almost any amount.

Dry Feeders

Dry chemical feeders are, in general, of two types: Volumetric and gravimetric.

Volumetric feeders measure by volume for introduction of the chemical

Fig. 1. View of several volumetric feeders; chemical feeds from hopper above to revolving table, from which knife deflects it to tank below

(Courtesy Infilco)

into the system. On the volumetric dry feeder shown in Fig. 1, the chemical is taken from the storage hopper on a circular feed table which revolves at a constant slow speed below the storage hopper, and a multi-section feed knife extends into the chemical within the drum, deflecting the chemical from the table. The amount deflected depends upon the position of the feed knife as well as the number of knives used. The feeder may be calibrated with any given chemical of a relatively uniform composition to show the number of pounds delivered per minute or per hour for various settings of the feed knives.

The chemical removed from the table is dissolved in a dissolving pot, agitated either by a vortex action of the dissolving water, or by a small motor-driven agitator. For other types of chemicals that will not dissolve—for example, activated carbon—a small agitator or vortex is employed to obtain a slurry of chemicals as fed.

Still another type of volumetric feeder works on the principle of an **oscillating plate** at the discharge of the chemical feed hopper, the length of the stroke of the plate and the depth of the chemical on the plate being adjustable to obtain varying rates of discharge. Pebble lime is commonly fed volumetrically through a **rotating spool type** of feeder.

Any volumetric method of feed of chemicals can only be as uniform as the uniformity in weight or consistency of the chemical itself. If the density of the chemical is subject to any appreciable variation in the number of pounds of chemical to the cubic foot, then this same variation will appear in the rate of chemical feed from this type of feeder. Certain chemicals have a tendency to "arch" or to "hang" in the feed hopper and require devices in the hopper to give a positive agitation or vibration. Where such devices are employed, care is necessary to avoid packing of the chemicals that would in turn lead to a variation in the actual rate of chemical feed.

Gravimetric Feeders—The second type of dry feeder commonly used is a gravimetric feeder. In such a unit, the chemical is fed by weight and, whereas a volumetric type of feeder may show a variation as high as plus or minus 5 per cent in actual rate of chemical feed due to variation in consistency, the gravimetric feeder will seldom show a variation of more than plus or minus 1 per cent or 2 per cent. In the gravimetric feeder, the chemical is fed to a traveling belt, and the gate admitting the chemical to the belt is regulated by the total weight of the belt assembly plus the chemical to maintain a constant weight. The rate of feed may be varied by the speed of the belt.

Gravimetric feeders are considerably more expensive than volumetric feeders and are justified only in the larger water treating plants where the added accuracy or constancy of chemical dosage becomes an important factor. The discharge from the gravimetric portion of the unit may be to a solution pot, vortex mixer, or agitator of some design to maintain a uniform concentration. Water is invariably used as the means for conveying the chemical from the feeder to the point of application.

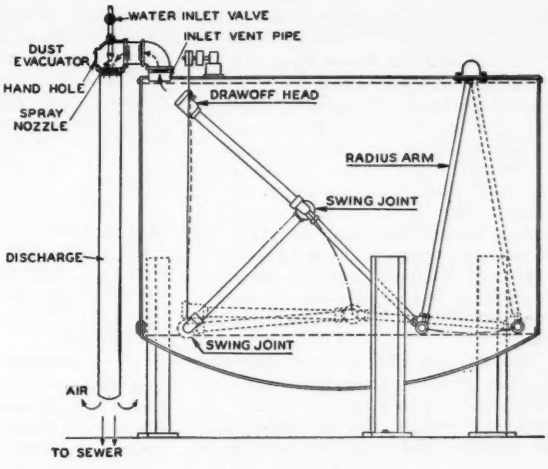


Fig. 2. View of a decanting feeder. This lowers liquid level in solution feed tank at desired rate, either constant or proportional to flow of water to be treated

(Courtesy Permutit Co.)

Wet Feeders

Practically all solution type feeders are based on the principle of introducing a known quantity of chemical to a known quantity of water, so that a chemical solution of known concentration is prepared. The volume of this chemical solution introduced to the water system is then controlled. This chemical solution may be fed into open systems by gravity or introduced into closed systems by means of a chemical feeder discharging to a pump suction box, to which further dilution water is added. By means of a centrifugal pump, the chemical solution is pumped to the point of application. The chemical solution may be pumped directly from the solution tank to the point of application in controlled volume by controlled volume pumps.

The simplest form of a gravity solution feeder is a **decanting feeder,** shown in Fig. 2. There are several modifications of this general design, but all function by lowering of the liquid level in the solution feed tank at a desired rate by overflow, either into a swing pipe located within the tank, or into an overflow hose with a dropping device located on the outside of the tank. With a constant tank diameter and a known strength of chemical solution, this level in the tank may be lowered at a controlled rate, actuated by a small motor or other electrical device. The rate of lowering may be either constant or at a rate actuated for proportional feed of the chemical to the flow of water to the system.

Another type of solution feed employs the principle of maintaining a constant liquid level head over an orifice. In such a device, the flow of chemical solution from a storage tank is float controlled to a constant level box, and a V-Port or similar type of orifice on which the degree of opening may be varied is located in the bottom of this box. In such a feeder, the liquid head over the orifice is usually 8 in. to 12 in. This type of liquid feed should not be used where there are any undissolved materials in suspension, or where there is any possibility of dirt being present in the chemical solution that might tend to coat or plug the orifice.

There are a number of types of **displacement liquid feeders** available. One type of such feeder is the so-called "pot" feeder in which a quantity of the solid chemical is placed in the pot in lump form and a small stream of water introduced at the bottom of the feeder and a solution of the chemical feed taken from the top of the feeder to the point of application. The amount of water passed through the feeder, and hence the quantity of chemical feed, may be made approximately proportional to the flow of water by taking the feed line to the pot from the pressure side

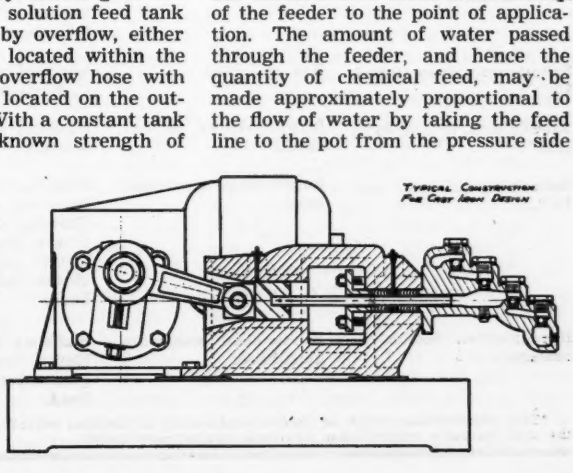


Fig. 3. Cross-section of a typical controlled volume pump for feeding chemicals. This one has ball valves. Volume delivered is varied by changing stroke of pump through mechanical linkage or by changing motor speed

(Courtesy Milton Roy Pumps)

of a venturi or an orifice, discharging to the line at the downstream side.

Feeding in Slurry Form

Certain chemicals, such as lime, activated carbon, and gypsum, must be fed in a slurry form, due to either limited solubility or, as in the case of activated carbon, to the fact that the chemical does not dissolve at all in water. The water in each case is a conveying medium and, in order to obtain an accurate feed of such a chemical, it is necessary to maintain a uniform suspension or a uniform concentration of the chemical in the slurry.

Several types of agitators are used for this purpose, some horizontal and some rotating in a vertical plane. On any such feeder, the agitation must be positive and must be such as to avoid any stratification of the suspended solids at any point in the feed tank or in the zones of mixing.

In larger water softening plants, certain economies in the treatment are available through the use of live lime (CaO) and slaking the lime at the plant at the time of its use for treatment. The lime may be slaked by batch process and fed from decanting types of feeders. Gravimetric feeders may introduce the pebble or live lime directly to a slaker, continuously slaking the lime and taking the effluent from the unit to the treating process.

Controlled Volume Pumps

Where a chemical solution or a slurry is to be introduced into a water line under pressure, or into a tank under pressure, controlled volume chemical pumps are commonly used. These pumps act to measure exactly, by volumetric displacement in the pump chamber with each stroke of the pump, the chemicals to be introduced to the system and to discharge these chemicals in a controlled volume that does not vary with any variation in the discharge pressure. So the net effect is to meter the chemical solution at the same time it is pumped.

To meter the chemical accurately, the pump should be properly designed to handle water treating chemicals and a typical design is shown in Fig. 3. A double ball check is used on both suction and discharge of this pump, so that if a small crystal or slurry particle lodges under one of the ball checks, the chances are that the second ball will hold and give positive check valve action when pumping chemicals. This is designed to automatically discharge any air entering the valve, to eliminate any possibility of collection of an air bubble in a pocket that would compress and then expand, thus destroying the volumetric measuring capacity of the pump. The volume of chemical delivered may be readily varied by changing the stroke of the pump or the speed of the motor drive. Such a method of chemical feed is accurate to within approximately 1 per cent to 2 per cent.

Table showing Materials of Construction—Water Treatment Chemical Feed Systems

CHEMICAL	TANKS AND PIPE LINES	PUMPS AND VALVES
Lime, soda ash (sodium carbonate), caustic (sodium hydroxide), 10% max. concentration. Alkaline orthophosphates (pH over 8.5), sodium nitrate, sodium silicate, sodium sulfite, sodium sulfate.	Iron and steel, wood.	Iron and steel body, stainless steel trim.
Caustic (sodium hydroxide) (over 10% concentration or hot).	Iron and steel in cold, stainless or monel hot or for long service.	Stainless or monel body and trim.
Neutral orthophosphates, pyrophosphates, metaphosphates.	Iron and steel, wood.	Moly-stainless steel, type 316.
Monosodium phosphate, phosphoric acid (cold, purified and dilute).	Monel or stainless clad steel. Rubber-lined. Lead-lined.	Moly-stainless steel, type 316 SMO body and trim.
Alum.	Rubber-lined, lead-lined. Everdur (silicon) bronze piping, phosphor bronze piping.	Everdur bronze body, monel or Hastelloy C or D trim. Methyl acrylate plastic (Plexiglass or Lucite). Rubber, lead lined, glass.
Ammonium hydroxide.	Iron and steel (avoid copper and copper alloys).	Iron and steel (avoid copper and copper alloys).
Ferrous sulfate and ferric sulfate.	Lead-lined. Rubber-lined.	Hastelloy C, Hastelloy D trim. Lead or rubber lined. Methyl acrylate plastic (Plexiglass, Lucite), glass.
Ferric chloride.	Rubber-lined.	Hastelloy C, Hastelloy C trim. Rubber or glass. Methyl acrylate plastic (Plexiglass, Lucite).
Sulfuric acid, concentrated, 80%+.	Iron and steel.	Iron and steel body, Hastelloy C, Hastelloy D trim.
Sulfuric acid, 10% to 80%, cold.*	Rubber-lined or lead-lined.	Hastelloy C, Hastelloy D trim. Worthite. Lead lined. Glass.
Sulfuric acid, less than 10%.	Rubber-lined and lead-lined.	Hastelloy C body. Hastelloy C, Hastelloy D trim. Worthite, Hastelloy C or D trim. Everdur bronze, Hastelloy C or D trim. Methyl acrylate plastic (Plexiglas or Lucite). Glass or rubber lined.
Hypochlorites, sodium or calcium.	Rubber-lined, stoneware, glass-lined.	Hastelloy C, Hastelloy C trim. Methyl acrylate plastic (Plexiglas or Lucite). Glass or rubber lined.

*This concentration range of sulfuric acid should be avoided wherever possible, as this is the most corrosive concentration for attack against most metals.

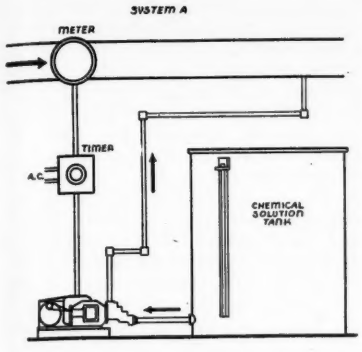
Materials of Construction

The materials of construction used for chemical feeders, pipe lines and appurtenances with which the chemical solution may come in contact before being introduced and diluted in the water, are of prime importance to insure proper operation and long life for the equipment. The accompanying table shows the usually applied materials of construction on the common chemicals used for water treatment. This list is not intended to be all-inclusive, as there are materials other than those mentioned that will give satisfactory service, but may be used as a general guide.

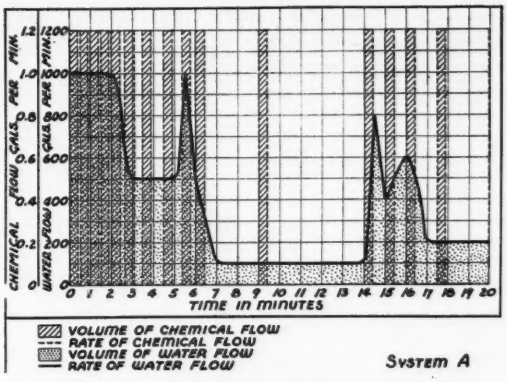
Proportional Feed Systems

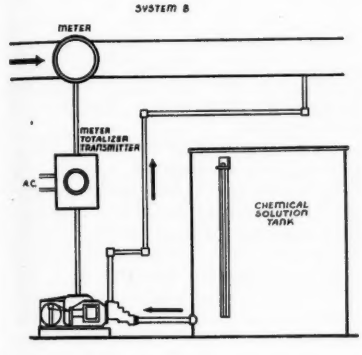
Chemical treatment systems may be designed for constant treatment, that is, for the chemical feeders to operate at a constant rate, delivering the required quality of chemicals or concentration of chemicals in a unit of time. This is the simplest form of chemical feeder. Where water is made up to a large reservoir or clear well, a constant rate treatment system may be designed, with feeders operating at known rates for a constant and known flow of water, the flow being turned off and on between certain levels in the reservoir. A minimum of 4 to 6 hours' storage is normally required for this type of system.

Where there is a variation of flow, a proportional feed of chemicals is desired so that the rate of chemical feed will be varied to meet the rate of flow, in order that each unit of water passing through the system will receive the same chemical treatment.

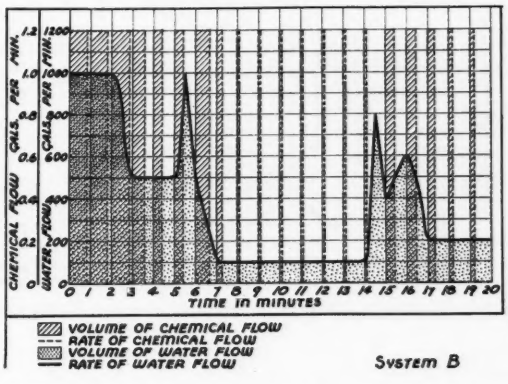


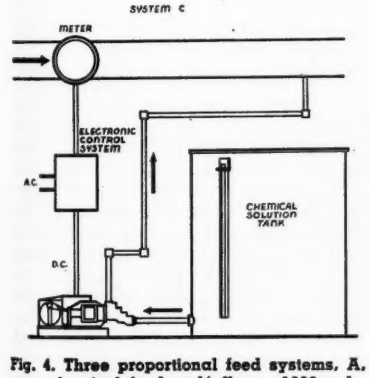
SYSTEM A at left, diagram of operation at right. One electrical contact to timer from meter every 500 gal flow. Timer holds controlled volume pump in operation for 25 sec, pumping at 1.2 gpm to give average ratio of 1 gal chemical solution per thousand gallons main line flow





SYSTEM B at left, diagram of operation at right. Meter totalizer transmits a time impulse to controlled volume pump for percentage of total time cycle of 50 sec in each minute, corresponding to percentage of maximum flow, holding pump in operation at 1.2 gpm to give average ratio of 1 gal chemical solution per thousand gallons main line flow





SYSTEM C at left, diagram of operation at right. Meter actuates potentiometer for electronic system. Alternating current used to electronic system. Direct-current motor on controlled volume pump runs at speed directly variable with flow of water in main line, changing instantly with any change in rate of flow indicated by meter. Controlled volume pump operates continuously, delivering 1.0 gpm when main line flow is 1000 gpm, 0.5 gpm when main line flow is 500 gpm, and 0.1 gpm when main line flow is 100 gpm, etc

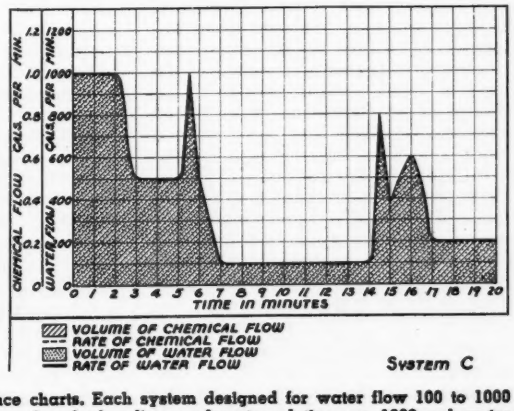


Fig. 4. Three proportional feed systems, A, B and C and their performance charts. Each system designed for water flow 100 to 1000 gpm, chemical feed at ¼ lb per 1000 gal, dissolved in 1 gal of solution, or 1 gal of sodium carbonate solution per 1000 gal water flow in line

Three typical systems of proportioning are illustrated in Fig. 4. Each of these is based on proportioning a chemical to a water flow in a line, and for the purpose of this illustration, a variation in flow between 100 to 1000 gpm has been assumed. The system is further based on adding, for example, sodium carbonate (soda ash) to this water at the rate of ¼ lb of the soda ash to 1000 gal of water flow in the line, using for this purpose a controlled volume pump. The soda ash is dissolved, ¼ lb to 1 gal of water, so that the proportioning system should give 1 gal of chemical solution to each 1000 gal of flow in the water line.

Systems A and B, Fig. 4, illustrate the common type of proportioning system that has been employed in most installations up to the present. In system A, a contact from the meter to the timer permits the timer to operate the pump for a definite period of time, for example, in this case, for 25 sec, pumping at 1.2 gpm. A second contact would be made at 30 sec, and the pump would again pump for 25 sec, so that over a period of 1 minute, the pump has delivered 1 gal of solution to the water line for 1000 gal of water that have passed in the line.

During the actual pumping, however, it has been necessary to introduce a slight excess of treatment. When the rate of flow drops, for example, to 500 gpm, as shown between the 3rd and 5th minutes, chemical is being fed slightly less than half the time, and when it is being fed, the water being treated at that moment receives more than twice the average dose. When the flow drops to 100 gpm, there is an interval of several minutes with no treatment added, but at the beginning of the 9th minute, the meter has made a contact and the chemical fed for the next 25 sec is 6 times the quantity required for actual treatment. Immediately following the stopping of the chemical pump on to the 14th minute when the next injection starts, no chemical has been added to the system.

System B, Fig. 4, is a modification of system A through the use of a totalizing device that adds up the flow of the previous minute to give a contact to determine the portion of

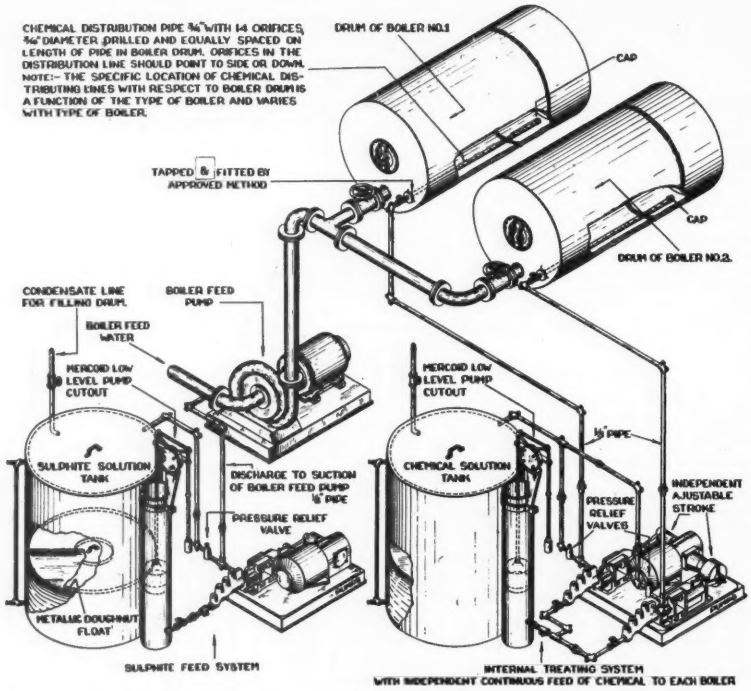

CHEMICAL DISTRIBUTION PIPE ¾" WITH 14 ORIFICES, ¾" DIAMETER DRILLED AND EQUALLY SPACED ON LENGTH OF PIPE IN BOILER DRUM. ORIFICES IN THE DISTRIBUTION LINE SHOULD POINT TO SIDE OR DOWN. NOTE:- THE SPECIFIC LOCATION OF CHEMICAL DISTRIBUTING LINES WITH RESPECT TO BOILER DRUM IS A FUNCTION OF THE TYPE OF BOILER AND VARIES WITH TYPE OF BOILER.
DRUM OF BOILER NO.1
CAP
TAPPED & FITTED BY APPROVED METHOD
CAP
DRUM OF BOILER NO.2.
CONDENSATE LINE FOR FILLING DRUM.
BOILER FEED PUMP
BOILER FEED WATER
MERCOID LOW LEVEL PUMP CUTOUT
MERCOID LOW LEVEL PUMP CUTOUT
½" PIPE
SULPHITE SOLUTION TANK
DISCHARGE TO SUCTION OF BOILER FEED PUMP ½" PIPE
CHEMICAL SOLUTION TANK
INDEPENDENT ADJUSTABLE STROKE
PRESSURE RELIEF VALVE
PRESSURE RELIEF VALVES
METALIC DOUGHNUT FLOAT
SULPHITE FEED SYSTEM
INTERNAL TREATING SYSTEM WITH INDEPENDENT CONTINUOUS FEED OF CHEMICAL TO EACH BOILER

Fig. 5. Perspective diagram of complete chemical feed system for internal treatment of boiler feedwater (Courtesy Milton Roy Pumps)

the following minute for which the pump or chemical feeder will operate. This has the same inherent disadvantages as system A; namely, overtreatment at points of low flow at the time of the chemical slug, with no treatment in between. Where the chemical is added to a tank or to a point where the water is retained for a sufficient period of time to permit averaging of the treatment, these systems of feed will approximate the true proportionality factor and will give fully satisfactory results. In treatment of a liquid flow in a pipe, these systems leave much to be desired.

System C, Fig. 4 illustrates a new development that eliminates the disadvantages of Systems A and B and is a practical application of electronic control. The chemical pump or feeder operates continuously, but with a motor speed directly proportional to the flow of water in the line that is being treated. Thus each portion of flow is treated with its proportionate amount of chemical, and the area under the water flow curve represents the quantity of chemical added to treat the water flow, the chemical flow curve being exactly parallel to the water flow curve.

The application of this principle to chemical feed in water treatment is an advance in this science and a direct practical application of electronics. Alternating current at the plant is used for the system and converted at the electronic circuit to direct current. The motor of the pump or feeder is a dc motor. A potentiometer to regulate the speed of the motor is mounted in the water meter and the potentiometer setting is immediately changed with any change in the rate of water flow. The speed of the motor is constant for a given potentiometer setting regardless of the load on the motor, any compensation for variation in the load being automatic in the electronic circuit. This system of motor actuation may be used on controlled volume chemical pumps, decanting feeders, or dry feeders.

Chemical Feed to Boilers

Sodium sulfite feed system—A complete chemical feed system for internal treatment of boiler feedwater is illustrated in Fig. 5. Sodium sulfite should be fed continuously to the boiler feedwater following the open or deaerating heater to react with and remove any residual dissolved oxygen not removed by the heater. It should be fed in sufficient quantities to be present at all times in excess of that required for the actual reaction. The boiler water may be tested for excess sulfite, the presence of which in sufficient concentrations is evidence of sufficient feed of sodium sulfite to the boiler feedwater.

If the sulfite is not fed continuously, the oxygen in the untreated water passed to the boiler may act to corrode in the boiler feedwater pump, corrode and pit economizers, or flash into steam in the boiler before it has an opportunity to react with sodium sulfite that may have been fed before by shots to the boiler. The sulfite feed, therefore, must be **continuous** in order to be effective. Some time is required for the reaction of sodium sulfite with oxygen to form sodium sulfate. It is, therefore, important that it be fed at a point as far back of the boiler feed pump close to the feedwater heater as possible, or even to the storage space of the feedwater heater.

Normally, 10 lb of sodium sulfite are required for each pound of dissolved oxygen in the boiler feedwater. There will seldom be more than 0.1 to 0.3 ppm of dissolved oxygen in the boiler feedwater, hence there is seldom more than 3 lb of sodium sulfite required per million pounds of boiler feedwater. This should normally be fed in concentrations not exceeding 5 per cent, although 10 per cent concentration is practical on this chemical. A controlled volume pump is best suited for sodium sulfite feed to assure the continuity of feed required, and a capacity of 3 gph on such a pump will usually handle sufficient sulfite solution for practically any boiler feedwater system, although this should be individually checked for each system.

As the purpose of sodium sulfite is to react with dissolved oxygen, the solution in the tank should be protected, insofar as possible, from contact with air. This may be done by furnishing the solution tank with a float, minimizing contact with air. A complete sodium sulfite feed system including the controlled volume pump, solution tank and accessories, can usually be furnished at a cost between $250 to $300. The small quantity of sodium sulfite needed to insure against dissolved oxygen corrosion is well worth the small cost involved.

Internal Treatment System

Internal treating chemicals are added to precipitate calcium and magnesium salts, to control alkalinity and to give conditions in the boilers that will prevent corrosion and embrittlement. Such chemicals should be introduced directly to each boiler drum and not introduced through the boiler feed line. When fed through the boiler feed line, there is possible interference with level controllers, meters, etc. Deposits may form that would actually cause plugging of the boiler feedwater lines. Feed directly to the boiler drum introduces the chemicals at a point where the reaction is desired; namely, in the boilers.

Controlled volume pumps are ideally suited for this service, with one pump chamber feeding to each boiler drum as in Fig. 5. This permits accurate control of the quantity of chemical fed to the individual boiler and the volume introduced may be readily changed by adjustment of the capacity on the individual pump.

It is not possible to successfully take a discharge from a single pump and valve it to a manifold to the several boilers, for the volume of chemical to be pumped is quite small, usually 3 to 10 gal per hour. An attempt to divide this small flow accurately may easily result in a plugged valve in this chemical line, causing the chemical pump to force the chemi-

cal solution through the relief valve back to the feed tank.

If the chemical solution is made up with condensate in the tank, it is possible to operate the pump continuously without the danger of plugging the chemical feed line or requiring flushing of the chemical feed line with condensate. Condensate flushing of the controlled volume pump is sometimes provided after each injection of phosphate with the phosphate injection on a time-operated cycle, but this is not necessary in most cases.

Considerations in Internal Treatment

Phosphates, caustic, soda ash, organics, or other treating chemicals that may be used for internal treatment may be fed through such a system. Proportional feed is possible, either by timed operation from contacts on a meter, or by operation with electronic control as previously described. As the water is retained in the boiler in concentrated form, the lag between periods of feeding is not as important as where treatment is fed to a line continuously. Electronic control, however, will give far more satisfactory results with sodium sulfite feeding where proportional feed of sodium sulfite to the boiler feedwater is desired. Cost of a simple type of phosphate feed system will vary from $150 per boiler to $400 per boiler, depending on the size of the pump, materials of construction, capacity, etc.

Typical Boiler Feedwater Treatment System

Figure 6 is an architectural flow sheet of a typical water treatment plant required for a power house operating on water taken from a nearby stream, the Republic Steel Corp. at Alabama City, Ala. This water treatment plant has a capacity of 400 gpm. The treatment process is as follows:

A. Clarification and silica reduction by coagulation with ferric sulfate, lime and soda ash
B. Gravity filtration
C. pH controlled sulfuric acid feed for neutralization of excess alkalinity to pH 7.5 to 8.0
D. Carbonaceous zeolite softening
E. Continuous sodium sulfite feed to boiler feed line
F. Continuous internal treatment direct to boiler drums

Practically all types of chemical feeder, with the exception of dry feeders, are illustrated in this system. The external treating chemicals to the clarifier are fed proportional to the water flow to the clarifier. Decanting types of feeders are used for ferric sulfate and soda ash. A lime slurry feeder is used for lime, in which a horizontal paddle system maintains a uniform slurry of the lime. The clarified and filtered water is treated with dilute sulfuric acid, the feed being automatically regulated by the pH value of the neutralized water through a Leeds & Northrup pH controller, for it is necessary to neutralize this alkalinity before feeding the water through a carbonaceous zeolite softener. This softener removes the residual hardness remaining following the external treatment. Sodium sulfite is added continuously to the boiler feed lines through the use of a Milton Roy controlled volume pump and phosphate is fed individually to each boiler drum through high-pressure Milton Roy pumps.

Non-technical operators of limited experience and no chemical or technical background were trained to operate this water treatment plant. It has been in continuous operation since January, 1943, successfully treating a flashy raw water supply for water to boilers that are rapid steam generators operating at 350 psi.

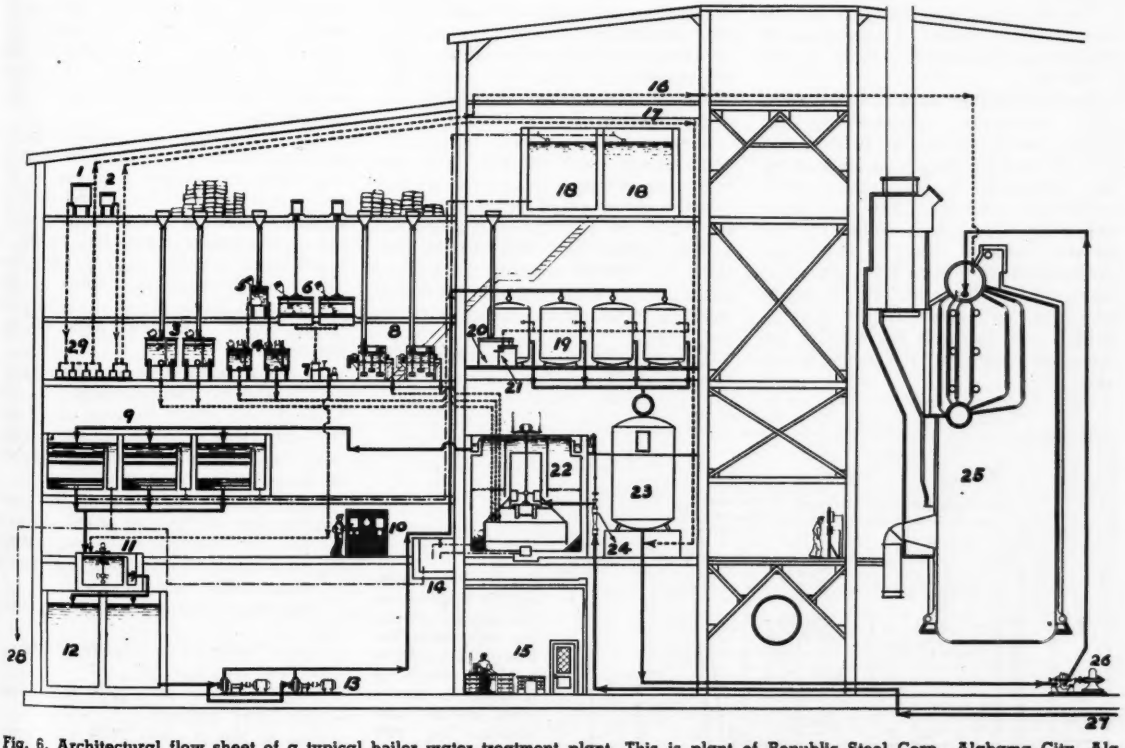


Fig. 6. Architectural flow sheet of a typical boiler water treatment plant. This is plant of Republic Steel Corp., Alabama City, Ala. Functional design by W. H. & L. D. Betz. Plant design and engineering by United Engineers & Constructors, Inc

1—Phosphate
2—Sulfite
3—Soda Ash Feeders (2)
4—Ferric Sulfate Feeders (2)
5—Ferric Sulfate Dissolving Tank
6—Sulfuric Acid Dilution Tank (2)
7—pH Control Acid Feed
8—Lime Feeders (2)
9—Gravity Filters (3)
10—Meter Panel
11—Neutralizer
12—Filtered Water Storage
13—Booster Pumps (2)
14—Sludge Sump
15—Laboratory
16—Chemical Line to Boiler Drum
17—Sulfite Line to Feedwater
18—Backwash Water Storage Tank
19—Carbonaceous Zeolites (4)
20—Salt Tank
21—Brine Tank
22—Clarifier
23—Deaerating Feedwater Heater
24—Raw Water Venturi
25—Boiler
26—Boiler Feed Pump
27—Raw Water In
28—To Waste
29—Controlled Volume Chemical Pumps

Remodeling the Coal Handling System at Hell Gate Station

When a new 65,000 kva topping turbine and two 975,000 lb per hr boilers were installed at Hell Gate Station of the Consolidated Edison Co. of New York, last year, it became necessary to rearrange the existing coal handling system to a considerable extent. This was done as described in this article by Mr. Roberts. All changes in coal handling arrangements were made while the station continued in operation.

By R. T. Roberts

Assistant Division Engineer, Mech. Eng. Dept., Consolidated Edison Co. of New York, Inc.

IN THE SPRING OF 1944, the WPB advised the Consolidated Edison Company of New York, Inc., to proceed with design and erection of a topping turbine and two high pressure boilers in the Hell Gate Station at 134th Street and Locust Avenue, New York City.

Design of the installation was started at once. The turbine was to be 65,000 kva, and the two boilers were each to deliver a maximum of 975,000 lb of steam per hour at 950 F, 950 psi.

The two boilers were to occupy the space formerly occupied by six smaller boilers known as Rows 1 and 2 which had previously been sold by the Company. These boilers were singly set, three to a row and were stoker fired from both ends. The remaining boilers, Rows 3 to 7, are stoker fired while Row 8 is pulverized fuel fired. All these boilers are singly set, three to a row. The 91 and 92 Boilers are set side by side in an extension South of the main boiler room.

The drum centers of the new boilers are to be approximately at elevation 122 ft or 111 ft above the basement floor, with tubular air preheater, flues, air ducts and precipitator above the roof. The existing coal handling system is at elevation 119 ft and with this boiler arrangement, the drum of one boiler would be directly across the cable road.

The then existing coal handling system consisted of three traveling coal towers having a total maximum lifting capacity of 875 TPH, each discharging through a double gated discharge hopper.

Serving these towers were two cable roads, each of 250 TPH, the inner one of which circled the station, and the outer one of which paralleled the inner, but in addition, also circled a coal storage pile West of the station via a coal trestle. The tower gates were arranged to discharge through motor driven gates to either coal road.

Either cable road was capable of serving all boilers, but the outer road only could be used to store or reclaim coal in the storage yard.

It was possible to relocate the outer cable road slightly to clear the boilers. Relocation of the inner cable road, however, while being possible for this boiler installation, would not be feasible with a second boiler installation, so it was decided to remove the inner road entirely and substitute a belt conveyor system for regular service. The outer road was left for stocking and reclaiming the coal which goes to storage. This cable road runs under the East gate of the coal towers.

The cable ways now discharge to bunkers situated on the West side of the boiler house, the bunkers so located that they can be served by coal larries which run between the boiler rows. On Boiler Rows No. 3 and 4 which have double ended stokers, the larries must serve two sides of the boilers. On Rows No. 5, 6 and 7, the larries serve the front ends of the boilers only.

In addition, there is a transfer hopper in the Southwest corner of the boiler house which delivers coal from the car system to an existing conveyor system for delivery to the No. 90 Row Boiler bunkers.

After the installation of the new boilers, now designated as No. 11 and 12, the coal burning rates for normal 24 hour winter period are estimated at about 3600 tons.

The tower capacities are respectively:

No. 1 North—275 TPH maximum—225 TPH average.

No. 2 Center—300 TPH maximum—250 TPH average.

No. 3—South—300 TPH maximum—250 TPH average.

It was felt that two towers might work at maximum or three at average capacity, so the belt conveyor system was set at an intermediate point between these two capacities. A 42 in. belt, traveling at 475 fpm would handle about 700 TPH, which was deemed sufficient and the speed

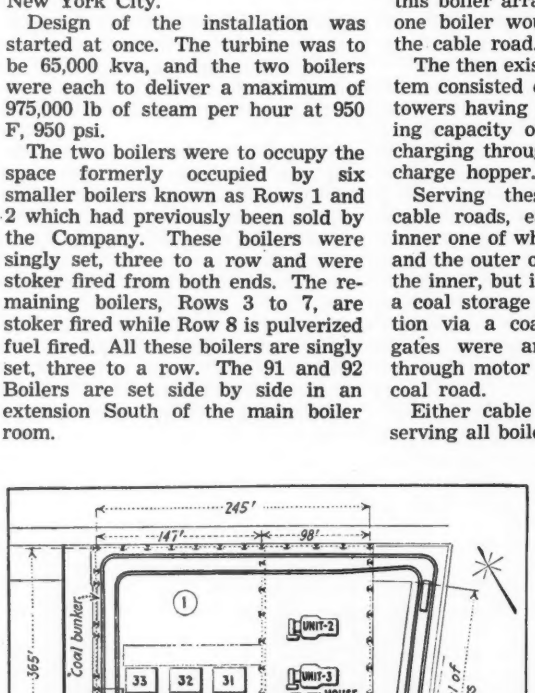


Fig. 1. Plan showing the original station cable road and the boiler units. The first and second row boilers were removed to make room for the new boilers. The new units are installed in the space marked 1

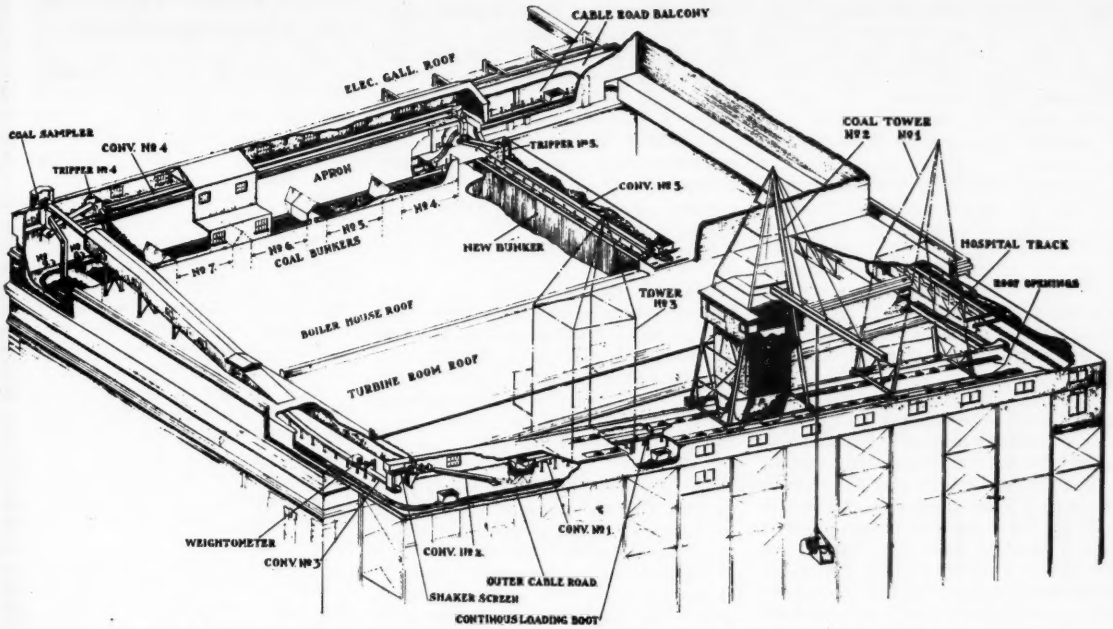


Fig. 2. Isometric drawing of the rearranged coal handling system in the entire top of the station

of 475 fpm would be an economical point at which high delivery would result, with low maintenance.

The relocation and removal of the cable car systems was scheduled to begin as soon as practical in order that the boiler erection schedule could be met, and if possible, to be ready for the Winter load period.

The outer cable way was relocated to the West of the No. 12 Boiler drum and carried on a balcony over a court yard. No other changes were necessary.

The inner cable way was removed except that portion to serve as hospital track over turbine room. Steel reinforcing and sheaves were designed in order to retain the inner cable way hauling machinery as spare equipment for the outer cable way. This outer track system will serve the existing boilers during alterations and as a spare system during belt conveyor outage.

The design of the steel work of the coal tower roof presented a problem in loading the belts from the traveling towers. This was finally overcome by breaking the conveyor run along the East side of the station into two sections. The North section, or Conveyor No. 1, is approximately the length of the travel of the towers, and is loaded from the towers by a continuous loading boot. The shorter section is Conveyor No. 2, and by this arrangement, the elevation of the No. 2 head pulley was substantially reduced, as well as a slight change in angle of run obtained to clear an expansion joint in the turbine room steel. Thirdly, because of the fact that a single 48 in. by 44 in. magnetic pulley would not handle the tonnage with the degree of protection desired, magnetic pulleys could be used in series at the heads of both No. 1 and No. 2 Conveyors. A shaking screen to remove rags, paper and non-magnetic material is installed at the head of No. 2 Conveyor.

The No. 3 Conveyor rises from the coal tower floor level to a new structure above the boiler house roof, crossing the South end of the turbine room. On this belt is located a weightometer, which, with an existing track scale, will record the coal consumption and storage.

At the head end of the No. 3 Conveyor is a coal sampling station. This consists of a 10 in. screw conveyor located in the discharge of the head pulley. This screw is driven by a motor and Universal gear reduction.

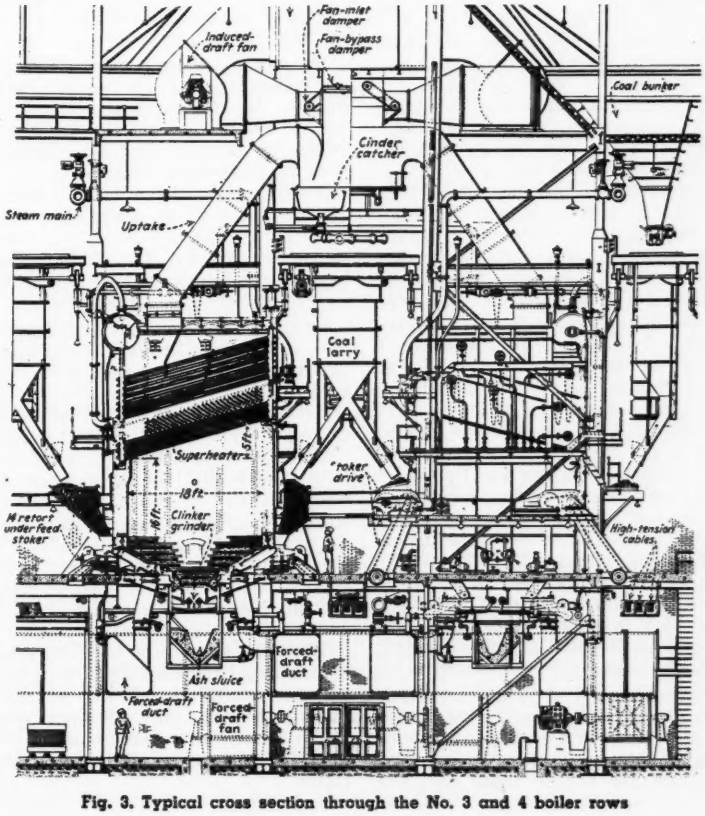


Fig. 3. Typical cross section through the No. 3 and 4 boiler rows

The coal enters the screw through a hole cut in the conveyor casing. This hole is covered by a blinder operated by a thrust or motor. The blinder uncovers the hole in the casing intermittently, thus obtaining the increment samples. The open time can be varied to increase or decrease the increments.

The coal sample is conveyed horizontally by the screw and discharge into a ring crusher, from which it passes to a Snyder ore sampler. The discharge of the ore sampler passes to a riffle where the ultimate sample is finally riffled into two 30 lb sample cans. Reject of the ore sampler and riffle discharge into the No. 80 coal transfer bunker.

The No. 4 Conveyor receives coal from the No. 3 Conveyor and carries this coal North above the boiler house room over the existing boiler bunkers.

The boiler bunkers for Boiler Rows No. 4 to 7 which load the coal larries have a very limited capacity. The No. 3 Bunker was removed due to interference with the new boiler installation so that the No. 4 Bunker serves as a transfer for coal for both the No. 3 and No. 4 Row Boilers.

The bunker capacities are as follaws:

New Bunker—2300 Tons
No. 4 Bunker—375 Tons
No. 5 Bunker—375 Tons
No. 6 Bunker—375 Tons
No. 7 Bunker—375 Tons
No. 8 Bunker—375 Tons
No. 9 Bunker—186 Tons

In addition, each No. 8 Row Boiler has an individual bunker of 100 tons and each No. 9 Row Boiler has an individual storage capacity of 525 tons. Total storage in the station is in excess of 5700 tons.

A traveling tripper on the No. 4 Belt discharges coal to the bunkers. This tripper is of the automatic self reversing type, and travels between Bunkers No. 8 and No. 4. With the limited bunker capacities of the old bunkers, it can be seen that with high boiler loads, this tripper may be almost constantly in motion as the belt delivery with adequate hoisting is such that a bunker can be loaded in about 35 minutes and will need reloading about every one and one-half hours. It is, however, possible to subdivide the coal stream so that any part can be discharged to the bunkers and any part returned to the belt to pass to the No. 5 Belt for use in the new boilers. Part can also be passed to a loading chute leading directly to the head of the existing "c" Conveyor for use in the No. 90 Boilers and thus bypassing the No. 90 Transfer Bunker and the existing "a" and "b" Belts. The loading boot of the No. 4 Belt also is arranged to load coal directly to No. 90 Transfer Bunkers, without passing over the tripper.

Coal passing to the No. 5 Conveyor is conveyed above the new coal bunker. This conveyor is also equipped with an automatic self reversing traveling tripper to distribute coal the length of the bunker. To serve the West end of the bunker which cannot be reached by the No. 5 Tripper Discharge, the loading boot of the No. 5 Belt is equipped with a back loading chute. The location of the No. 5 Belt is such that with the next installation of high pressure boilers, the conveyor will serve a duplicate bunker South of and abutting the present bunker. The tripper is equipped with chutes each side, the future one at present being blanked off.

Due to the fact that the No. 3 Bunker was removed to provide room for the new installation, coal for the No. 3 Row will pass through the No. 4 Bunker. It was also necessary to remove the larry which previously served the South side of the old No. 2 Row and the North side of the present No. 3 Row.

To provide coal for the No. 3 Row Boilers, a 13 in. side pull Redler Conveyor was installed directly above the stoker hoppers. This conveyor has a capacity of 40 tons per hour. A chute from the No. 4 Bunker supplies coal to the Redler, this coal being conveyed first to the North stoker hoppers. A simple slide gate system allows the Redler to discharge coal to the North hoppers of No. 33 Boiler first, then to Boiler No. 32 and then to Boiler No. 31. As each hopper fills, coal is automatically carried over to the next hopper. When the North hoppers are filled, the coal carries over to the South hoppers of Boilers No. 31, 32 and then 33, filling each in turn. As coal is used by the stokers, the bunker levels are automatically restored by this simple fall out type of delivery.

The conveyors are interlocked so that failure of the No. 5 Conveyor will stop the No. 4 Conveyor. Failure of the No. 4 Conveyor will stop the No. 3 Conveyor, etc., so that any failure stops all conveyors ahead.

Bindicators are provided to prevent overload in case of emergency shut down or loading difficulties. Crusher feeder motors on the coal tower feeders are interlocked to stop with stoppage of the No. 1 Conveyor.

Starting sequences are so arranged that the No. 5 Conveyor must start before the No. 4 Conveyor, and No. 4 before No. 3 Conveyor. The No. 3 Conveyor must start before the No. 2 Conveyor and No. 2 must start before No. 1. Start and reset buttons are so arranged that the operator must patrol the full length of each belt in starting, and in this way, observe that all belts are clear and personnel are not endangered. Cut-outs allow Conveyors No. 1, 2 and 3 to operate without No. 4 and 5, or No. 1, 2, 3 and 4 to operate without No. 5.

With this system for handling coal, it is felt that the existing boilers, and the new installation, will be adequately served, and adequate provision made for a contemplated duplication of the new installation in the future.

High Head Turbines for Mexican Plant

BALDWIN LOCOMOTIVE WORKS engineers are at work on the second of three turbines destined for a Mexican hydroelectric power plant which is to operate with the highest head for this type unit in the western hemisphere. The first turbine already has been installed and is in operation.

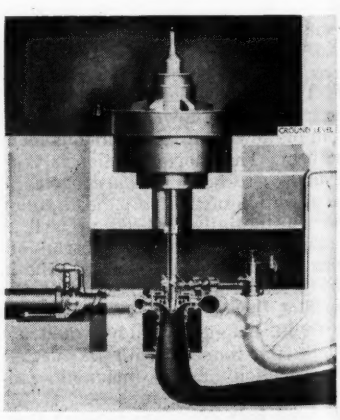
The turbines are part of the Ixtapantongo Dovelopment of the Comision Federal de Electricidad, located on the Tilostic River about 100 miles southwest of Mexico City, which is to furnish power through the Mexican Light and Power Co.

Each turbine is to furnish 39,000 hp under a head of 1,028 ft and the total additional power generated will take Mexico City off power rationing. At present current has been rationed so that citizens and industries are afforded power only for eight of each 24 hr.

The first turbine installed is reported to have the distinction of being the most powerful hydroelectric unit in Mexico and the highest head Francis type turbine ever built in this hemisphere. The unit is of the vertical shaft Francis type, and is provided with a butterfly valve and a Pelton relief valve to prevent pressure rises for load rejection.

This unit requires about 372 cu ft of water per second to develop full power. The runner, which contains the turbine blades, is 70 in. in diameter, and the weight of the complete unit is 260,000 lb.

Although the Tilostoc River flows to a lower level in the vicinity of the hydroelectric power site, engineers in designing the plant decided to dam its waters and to tap them at a far higher level beyond the mountain. Here they built a diversion dam directing the river waters through an open canal to a settling basin, where the quiet water permits the sand content to precipitate to the bottom. From this basin the water is conducted through a large pressure tunnel to a vertical surge tank, which is connected to three steel pipes, called penstocks. These penstocks feed the turbines in the power plant below.



Piping for Flow Meters*

By R. E. SPRENKLE

Hydraulic Engineer
Bailey Meter Co.

Correlation of piping-requirement standards for flow-meter accuracy—Piping requirements on inlet side of meters—Use of straightening vanes —Fittings allowed on outlet side of meters —Typical flow-meter piping arrangements

IN METERING any fluid through a pipe line, it is most important that the flow approach the orifice, flow nozzle, Venturi tube, pitot tube, or other type of primary element, in a normally turbulent state. It must not be influenced by swirls, cross-currents, eddies, or other disturbances which create helical paths of flow. Nor can there be any disturbance following the primary element, which would in any way cause interference with the static-pressure measurement at that point.

These conditions can best be controlled by providing adequate lengths of straight pipe on both sides of the orifice or other primary element. The necessity for doing this has long been recognized in fluid-flow literature.

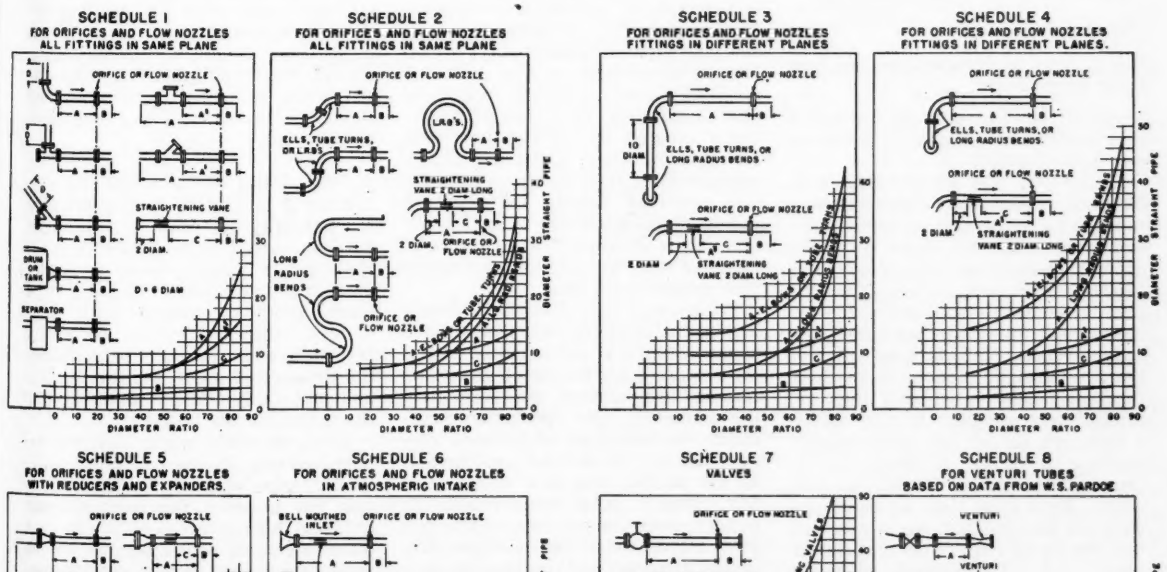
*Abstract of paper presented at the 1944 annual meeting of the ASME.

It is interesting to note that most of the recommendations given in papers and articles have been based on the standards of piping requirements established by the Joint AGA-ASME Committee on Orifice Coefficients, which appear as Sketches 1 to 5 of its 1937 Report.

In general these standards have been found quite satisfactory when properly used. It is only natural, though, that in their application to specific meter installations, many questions of interpretation should have arisen. Furthermore, additional data have been obtained from researches at the author's company, at the University of Pennsylvania, at the Case School of Applied Science, and at other sources, which both add to and make more clear these original standards.

It is the purpose of this paper, therefore, not only to correlate these data with those previously published but also to furnish a reasonable interpretative analysis of these requirements as reflected by results obtained from many actual field installations.

In doing this, however, the author hastens to disclaim any intention of implying that everything is now known about suitable piping recommendations for any and all combinations of fittings, bends, and turns with straight and curved pipe sections. On the contrary, this paper should be considered only as a progress report based upon experiences gained so far both in the laboratory and in the field. As a matter of fact, this subject well merits a great deal more research and field investigation before we can be sure all the standards established and the interpretations thereof can be considered as fully proved and beyond reproach. It is sincerely hoped that when such additional data are ob-



FITTINGS ALLOWED ON OUTLET SIDE IN PLACE OF STRAIGHT PIPE.	.0 – .50 RATIO	.50 – .60 RATIO	.60 – .70 RATIO	.70 – .80 RATIO
	1. TEES 2. 45 ELLS 3. GATE VALVES 4. SEPARATORS 5 Y-FITTINGS 6 EXPANSION JTS.	1. TEES 2. EXPANSION JTS. 3. GATE VALVES 4 Y-FITTINGS 5. SEPARATOR (IF INLET NECK IS ONE DIAM. LG.)	1. GATE VALVES 2. Y-FITTINGS 3. SEPARTOR (IF INLET NECK IS ONE DIAM. LONG)	1. GATE VALVE 2. LONG RADIUS BEND

Fig. 1. Piping requirements for orifices, flow nozzles and venturi tubes

tained they will be made public at the first opportunity.

For convenience in presenting the piping-requirement standards published in the AGA-ASME Report in 1935, together with the additional data obtained since then, eight piping groups or schedules have been set up, as shown in Fig. 1. The first seven schedules cover the use of "Orifices and Flow Nozzles," while the eighth applies only to "Venturi Tubes." Each schedule, except the eighth, shows the minimum lengths of straight pipe required for that particular piping arrangement, both on the inlet and on the outlet sides of the orifice or flow nozzle. Alternately, it also shows the lengths of straight pipe required on the inlet side when straightening vanes must be used in lieu of the longer runs of straight pipe.

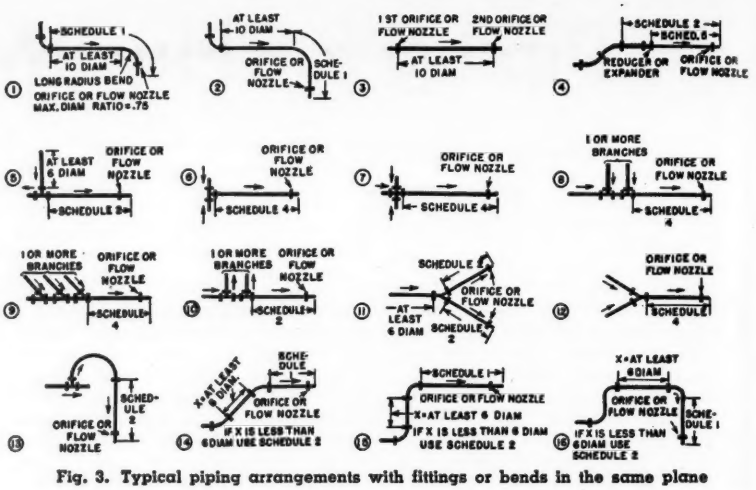


Fig. 3. Typical piping arrangements with fittings or bends in the same plane

Piping on Inlet Side

It will be apparent at once on examining Schedules 1 to 7, that the minimum required lengths of straight pipe on the inlet side of the primary element increase rapidly with (a) the diameter ratio of the primary element, and (b) with the complexity of the piping arrangement preceding the straight run. On the other hand, the

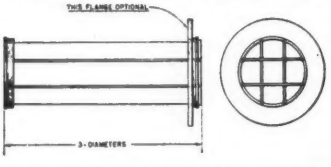


Fig. 2. Type of straightening vane generally recommended

length of straight pipe on the outlet side varies but little with these or any other factors.

Because of the abrupt change in direction produced by two elbows or tube turns at 90 deg to each other, compared with the more gradual change caused by two long-radius bends, considerably more straight pipe is required on the inlet side for elbows and tube turns than for long-radius bends. This is true whether there is straight pipe between these turns or bends, or whether they are immediately adjacent to each other.

Research so far has been entirely confined to turns or bends in the same plane, and at 90 deg to each other. Until such time as additional data are forthcoming, we recommend that the piping requirements of Schedules 3 and 4 be followed, when the bends are not in the same plane.

Attention should be called in Schedule 5 to the fact that the lengths shown apply only to the lengths of the increased or decreased diameter pipe and not to their required over-all lengths of straight pipe. Such over-all or total lengths depend entirely upon the nature of the fittings, valves, etc., which precede. For example, in the case of expanding an 8-in. pipe to 10-in., a 75 per cent diameter ratio orifice located in the 10-in. line would require 14 diam of 10-in. pipe, as shown in Schedule 5. If, however, two adjacent long-radius bends of 8-in. pipe, at right angles to each other, precede the expanded section the total length of straight 8-in. and 10-in. pipe would be determined from Schedule 4, which in this case would be 26 diam. Thus, there would be required a total of 14 diam of 10-in. pipe, plus a sufficient length of 8-in. pipe to make up an equivalent total length of 26 diam of 10-in. pipe.

As indicated, the data on Venturi-tube piping requirements, as shown in Schedule 8, was obtained entirely from Professor W. S. Pardoe's papers. His last paper supplied figures which were cross-plotted on the basis of diameter ratio versus the lengths of pipe required to eliminate all disturbances created by fittings preceding the straight pipe. Since the piping arrangements used by Professor Pardoe were not exactly the same as indicated in Schedules 1 to 7, they are shown separately in Schedule 8, together with the lengths of straight pipe required for each.

While no specific research and very little actual field experience have come to the author's attention covering piping requirements for pitot tubes, it is reasonable to assume, until proved to the contrary, that piping requirements for this type of primary element should be at least as stringent as for orifices and flow nozzles. In fact, there is some field evidence to indicate even longer runs of straight pipe are desirable on the inlet side, unless traverses are run to determine the point of average velocity, etc. More research and field experience are obviously needed to clarify this point.

Straightening Vanes

While straightening vanes are shown as alternative arrangements in each schedule, permitting shorter lengths of straight pipe on the inlet side, they should not always be considered as entirely equal to the longer runs of straight pipe in reducing flow turbulence. Especially is it desirable to limit their use to moderate line velocities, pressures, and temperatures, since application to high-pressure and high-temperature service involves special designs and materials to provide a safe installation. The preferable arrangement, no matter what the operating conditions may be, is to provide whenever possible the lengths of straight pipe specified in the schedules described, without resorting to the use of straightening vanes.

The recommended general design of straightening vanes is shown in Fig. 2. In cross section it resembles an "egg crate," with the spacings between plates not more than ¼ the inside pipe diameter. In measuring air in the atmospheric intake, as shown in Schedule 6, this spacing should be 1½ in. to 2 in., regardless of pipe size.

Piping on Outlet Side

From 2 to 4 diam of straight pipe are normally sufficient on the outlet side, as shown in Schedules 1 to 7, assuming a fitting, bend, or wide-open gate valve follows these 2 or 4 diam. Should a control valve, regulators, stop-check valve, or partly throttled gate valve closely follow the primary element, then at least 5 and preferably 6 diam should follow the orifice or the nozzle.

From the table in Fig. 1, it will be noted certain fittings can replace the straight pipe on the outlet side. While this list includes the use of seven different fittings up to a 50 per cent diam ratio, only wide-open gate valves and long-radius bends can immediately follow the orifice or nozzle at ratios in excess of 70 per cent. Incidentally, however, due to lack of physical clearances, it is impossible to install flow nozzles at the inlet to gate valves unless the face-to-face dimension is at least 18 in. In any case, it should be remembered that the preferable arrangement is the use of straight pipe immediately following the primary element.

All the thermometer wells, bulbs and sockets, thermocouples, resistance

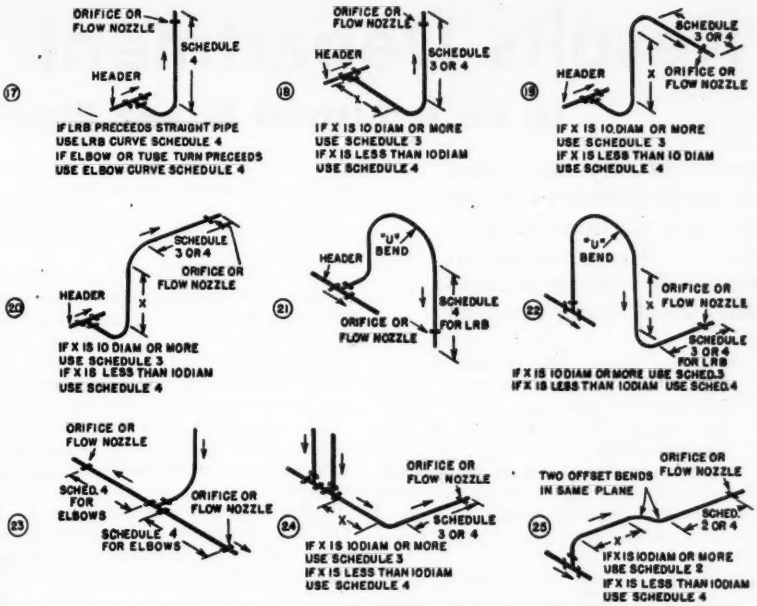

ORIFICE OR FLOW NOZZLE
SCHEDULE 4
HEADER
IF LRB PRECEEDS STRAIGHT PIPE USE LRB CURVE SCHEDULE 4
IF ELBOW OR TUBE TURN PRECEEDS USE ELBOW CURVE SCHEDULE 4
SCHEDULE 3 OR 4
IF X IS 10 DIAM OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10DIAM USE SCHEDULE 4
"U" BEND
SCHEDULE 4 FOR LRB
IF X IS 10DIAM OR MORE USE SCHED.3
IF X IS LESS THAN 10DIAM USE SCHED.4
IF X IS 10DIAM OR MORE USE SCHEDULE 2
IF X IS LESS THAN 10DIAM USE SCHEDULE 4
TWO OFFSET BENDS IN SAME PLANE
SCHED. 2 OR 4
SCHED.4 FOR ELBOWS
SCHEDULE 4 FOR ELBOWS

Fig. 4. Typical piping arrangements with fittings and bends not in the same plane

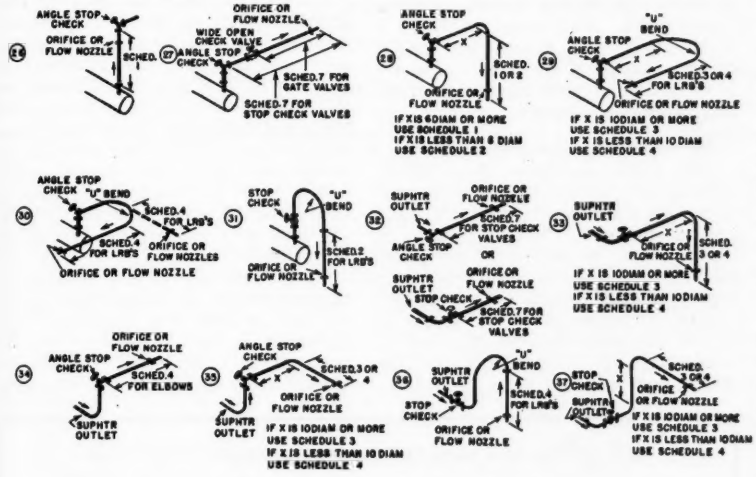

ANGLE STOP CHECK
ORIFICE OR FLOW NOZZLE
SCHED. 1 OR 2
WIDE OPEN CHECK VALVE
SCHED.7 FOR GATE VALVES
SCHED.7 FOR STOP CHECK VALVES
IF X IS 6DIAM OR MORE USE SCHEDULE 1
IF X IS LESS THAN 6 DIAM USE SCHEDULE 2
"U" BEND
SCHED.3 OR 4 FOR LRB'S
IF X IS 10DIAM OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM USE SCHEDULE 4
SCHED.4 FOR LRB'S
STOP CHECK
SCHED.2 FOR LRB'S
SUPHTR OUTLET
SCHED.7 FOR STOP CHECK VALVES
OR
SCHED. 3 OR 4
IF X IS 10DIAM OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10DIAM USE SCHEDULE 4
SCHED.4 FOR ELBOWS
SCHED.3 OR 4
IF X IS 10DIAM OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM USE SCHEDULE 4

Fig. 5. Typical boiler-outlet arrangements

elements, take-off nipples, etc., must be located at least 6 diam following the orifice or nozzle on the outlet side, or not less than 15 diam preceding it on the inlet side. The preferable location is on the outlet side.

When thermocouples are imbedded in the pipe wall in such a way as not to protrude into the pipe area, they may be located wherever desired.

Attention is called again to the fact that the lengths of pipe indicated in Schedules 1 to 8 are the minimum required in each case, and not the maximum. For best accuracy in metering, it is always desirable to provide the longest lengths of pipe possible, especially when the complete piping system on the inlet side includes a number of bends or fittings in different planes. It must be remembered that it is impossible, from a metering standpoint, to provide too much straight pipe.

Experience has indicated that the "Piping Requirement Standards," as shown in Fig. 1, Schedules 1 to 7, are not sufficiently complete and precise in themselves to enable one always to choose the correct location of an orifice or a flow nozzle in any particular piping layout. Further clarification or interpretation thus appears desirable in order to translate these standards into typical cases. To this end the author believes the diagrammatic sketches shown in Figs. 3, 4, and 5 will be helpful.

From arrangements Nos. 1 and 2, Fig. 3, it will be noted that a long-radius bend can itself be considered as so much developed straight pipe under Schedule 1, only if it is preceded by at least 10 diam of straight pipe. It cannot be so considered if it is preceded within a short distance by any fitting or valve or by another long-radius bend. Also note that in arrangement No. 1, an orifice or nozzle of a diameter ratio of 75 per cent or less can be placed at the outlet of a long-radius bend.

Arrangements No. 5 to 12, inclusive, emphasize the necessity of having long lengths of straight pipe when there are multiple-entrance flows or when the flow divides into one or more streams ahead of the primary element. Multiple-entrance flows in particular are quite apt to produce swirls or disturbances which are particularly difficult to eliminate. In a few instances, it has been found necessary to use a combination of these long lengths together with straightening vanes to obtain entirely satisfactory metering conditions.

Nos. 14, 15, and 16 illustrate the fact that with at least 6 diam of straight pipe between two long-radius bends, elbows, or tube turns in the same plane, the required lengths of straight pipe following the last fitting need be only that corresponding to Schedule 1. On the other hand, if the second fitting immediately or very closely (less than 6 diam) follows the first fitting, then Schedule 2 applies, as shown in arrangement No. 13.

The isometric views in Fig. 4 depict a few typical arrangements where the component bends are not in the same plane. All of these require lengths of pipe corresponding to Schedule 3 or 4 depending upon whether there is sufficient straight pipe between the preceding bends or not.

Since these boiler leads usually are rather short in length, it is necessary to start the study of the piping layout at the drum or superheater outlet. This is particularly true of those cases where the steam-flow orifice or nozzle must be located in the outlet from the boiler drum, as shown in Nos. 26 to 31, inclusive.

Note that in all cases when bends or turns closely follow the angle stop-check valve, as in Nos. 28, 29, and 30, this valve is considered as having the same effect as an elbow, thus requiring the lengths of straight pipe as called for under Schedules 2, 3, or 4, as the case may be; whereas when straight pipe immediately follows the valve as in No. 27, and when the orifice or nozzle can be located in this straight pipe, the requirements of Schedule 7 for stop-check valves apply.

When the angle stop-check valve follows the superheater outlet in a plane at right angles to the outlet, the requirements of Schedule 4 apply, regardless of the fact that the orifice or nozzle can be located in the straight pipe immediately following the stop-check valve. This is shown in arrangement No. 34, as contrasted with No. 27 in which Schedule 7 applies, because the angle check valve is not preceded by a bend or elbow, but by the boiler drum.

Building a Results Department
in an Industrial Power Plant

How it is being done gradually by one plant . . . Objective: to attain perfect steam-electric power balance . . . Uses and maintenance of instruments and controls . . . Measures taken to analyze losses or improve operating procedures in industrial processes yield many savings

IN A MID-WESTERN industrial plant, a power plant results department is being slowly developed, under war conditions and changing process requirements, that offers some valuable ideas for other industries to follow. The objective of this department, of course, is to bring the generation of steam and power plant services and their utilization as close to a perfect balance as possible.

In the particular plant referred to here, the development of a results department began about 5 years ago in the usual way, with the appointment of an instrument repairman in the new power plant, which had then been recently completed and put in operation.

Power Plant Heat Balance

The original power plant at that time contained five vertical bent-tube stoker-fired boilers generating saturated steam at 150-psi all electric power being purchased. The new power plant consisted of one 650-psi, 720-F pulverized-coal-fired steam generating unit and one 2500-kw condensing extraction turbine-generator for by-product power generation. Power required in excess of this by-product generation was to be purchased. The power plant was laid out and the factory piping systems remodeled so that there are four steam pressure systems, one operating at 650-psi for power generation, one at 125-psi for process, auxiliary drives and feed heating, one at 30-psi for process and heating and one at 10-psi for heating and feedwater systems.

Because of changes in processes and operating methods during the past years, there have been modifications of the original heat balance so that the present heat balance appears as shown in the accompanying diagram. The difference between the high electrical loads indicated and those generated indicates the amount of electric power purchased.

The results department in the new power plant consisted at first of the instrument repairman, whose duty was to supervise and maintain the power plant and factory instruments and controls. A comprehensive record system was gradually developed through which the performance of the power plant could be determined. Facilities were added from time to time for the repair of instruments and, with the coperation of the plant management and the power plant operating staff, there began to emerge the beginnings of a results department. Two years ago an Instrument and Results Department as such was formed, to function under the supervision of the chief power plant engineer.

It now consists of the results engineer, two girls to assist in keeping the record forms and several instrument repairmen for instrument repair work, instrument calibration and testing. This department under the supervision of the plant engineer, is co-ordinated with the engineering and process operations.

Instrument and Control Maintenance

The plant engineers department, through this results department, now does all its own instrument and control maintenance. The only equipment items it ever sends out of the plant for repair are gas-filled thermometer bulbs. It even repairs all its electric clocks. It attempts in all cases to utilize standard instruments and to adapt them to special purposes, for which, perhaps, they were not originally designed. But if standard instruments will not fit the conditions, special instruments are developed and fabricated for the purpose, often with great success.

To acquire the requisite knowledge of both the principles and the construction details of all sorts of power plant and process instruments and controls, constant study and work are required, also the close co-operation of manufacturers of this equipment.

The possibilities for savings in the power plant by proper control and measurement have been thoroughly explored during the past few years. Attention is now being given to a number of items in the industrial plant operations that may lead to improved steam-electric balance.

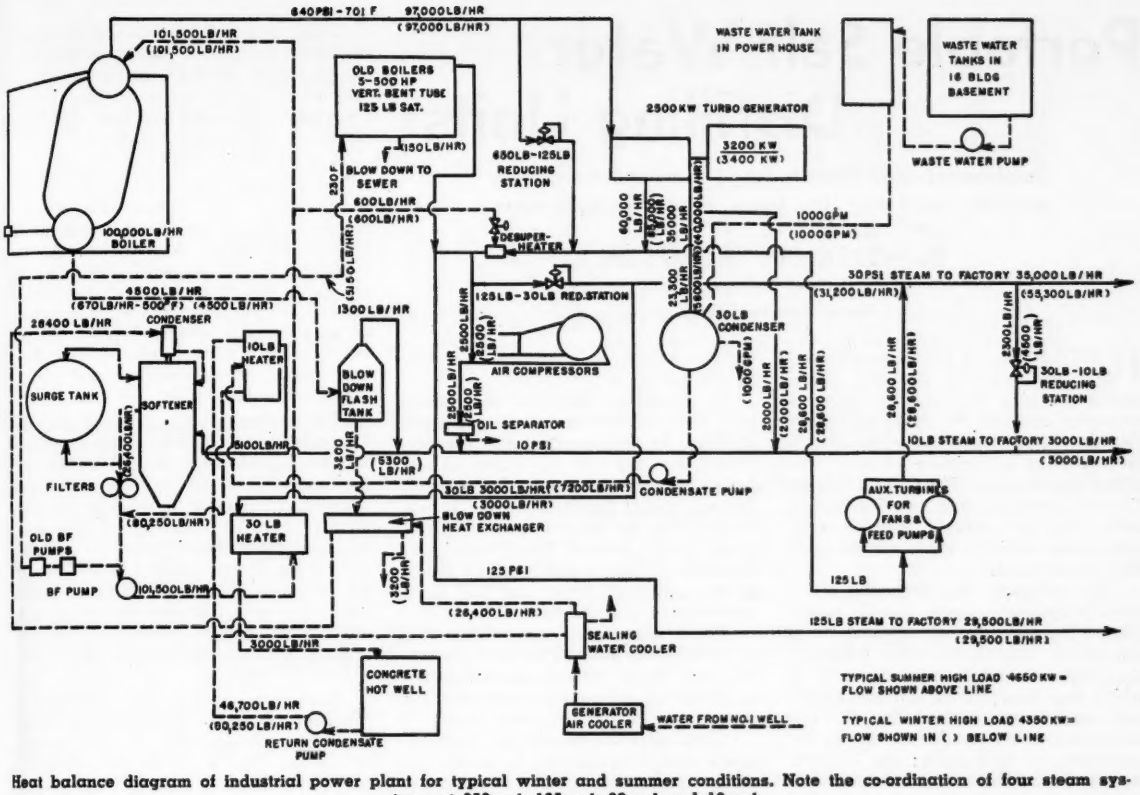
Condensing Losses

As seen on the heat balance diagram, the turbine generator is equipped with a small condenser, which goes into operation automatically in case there are any disturbances in the low-pressure steam systems or an electrical unbalance that might produce excess steam. The condition is complicated by the fact that when the processes are at maximum capacity in summer, there is no building heating load and the reverse is true in the winter.

At present one of the results department's jobs is an analysis of the amount of heat loss resulting from operation of the condenser. The results of a typical test period are shown in the table. Outside tempera-

Table showing heat losses resulting from condensing at power plant

Date	Btu Loss	Actual Steam Condensed—Lb	Outside Temperature Average Deg F
March 5	92,600,000	108,800	49
6	137,220,000	102,400	32
7	110,500,000	91,200	32
8	166,230,000	111,200	28
9	213,755,000	102,800	40
10	73,320,000	78,800	36
11 (Sunday)	13,155,000	1,600	40
12	55,680,000	46,800	40
13	140,650,000	129,600	43
14	176,400,000	188,800	54
15	178,200,000	212,400	60
16	223,850,000	286,800	64
17	350,900,000	522,800	55
18 (Sunday)	49,800,000	53,600	55
19	282,500,000	403,200	57
20	204,300,000	213,200	44
21	151,000,000	119,200	44
22	166,500,000	164,400	49
23	153,820,000	224,400	59
24	131,960,000	202,200	59
25 (Sunday)	7,200,000	21,200	67
26	218,040,000	350,400	60



Heat balance diagram of industrial power plant for typical winter and summer conditions. Note the co-ordination of four steam systems at 650 psi, 125 psi, 30 psi and 10 psi

ture given on this table is now being transposed into degree days, which will give a better basis for judgment. Shifting of the heat balance to eliminate this loss will of course result in a direct saving.

Water supply for condenser and processes had been given considerable thought in the original design of this power plant. All water is pumped from wells by centrifugal pumps. Originally the wells were not very deep but during the past few years, the water table in the region of the plant has been lowered a great deal, hence it is now necessary to use deep well pumps consuming relatively large amounts of power. Thus it is obvious that savings in pumping of condenser circulating and process water are worth striving for.

At present, water pumped from the wells at low temperature is sent first to air conditioning equipment throughout the plant. It is then pumped to process cooling equipment and from this flows to the waste tanks as shown and then is pumped through the turbine condenser. Consideration is being given to using this condenser circulating water for sprinkling lawns.

The plant engineer and the results department make constant studies of all heating surfaces in the industrial plant. Changes in steam pressure, type of heating surface and air circulating over a heating surface will increase its efficiency.

A constant study of motors is made to locate underloaded motors. Wattmeter readings and motor capacities are tabulated, thus identifying underloaded motors. If a new motor is needed anywhere of larger capacity, an underloaded motor can be used and a new motor purchased to replace only the underloaded one. A recent example of this was the need for a 30-hp motor which was met by shifting underloaded motors around until finally it was necessary to buy only a 7½-hp motor.

At night and over week-ends, even when the plant may be operating three shifts, certain equipment can always be found that can be shut down. All steam headers are valved off and shut down when possible. However, in doing this, it is necessary to make sure that all valves are tight, for a leaky valve completely nullifies the precaution. A careful maintenance program here shows great savings, without the purchase of valves or the spending of much money.

Another important factor in stopping losses is a careful program for training both power plant men and process men in the operation of steam valves and equipment. Process operators can be allowed to close steam valves but the plant engineer believes that only power plant men should be allowed to open them in starting up equipment. Process men often know little of the effects of water hammer, methods of draining and the like and by this ignorance can cause damage.

Bypasses are omitted from all traps wherever possible, on the ground that if the trap is correct for the job and is working right, no bypass is needed. With a bypass installed, someone may forget to close it. The argument for bypasses is that they prevent troubles caused by vacuum. However, this plant engineer believes that a suitable trap can always be found to fit the given conditions.

The department is giving some thought to the installation of a program control for its building heating systems to get them warmed up under varying work conditions. At present this is done only by verbal or written messages, and involves considerable judgment and human comfort sensations. An automatic control for this, as used in certain large office buildings, might save valuable heat units.

Fluorescent lighting for processes has many advantages, and one big advantage encountered in this plant is the elimination of glare. In certain processes, cellophane is used and in parts of the operation gets wrinkled. Under incandescent light, this wrinkled cellophane produced a glare that not only was bad for eyes but slowed up the work. This glare disappears under fluorescent lighting.

These are only a few of the typical items studied by the plant engineer and the results department in their attempt to achieve better co-ordination of all power and steam generation and utilization. They do not feel that they have a real results department yet but they are gradually developing it. And they have already accomplished a great deal in decreasing power service costs.

Portable Salt Water Distilling Units*

Development undertaken to supply Army and Navy needs produces equipment for many industrial applications

By WILLIAM H. THOMPSON
Chief Engineer
Davis Engineering Corp.

IN THE Spring of 1941 it became evident that portable distilling plants would probably be required in large quantities and both the Army and Navy Departments increased the scope of their investigations of suitable portable distilling plant designs. The Cleaver-Brooks Co. of Milwaukee had supplied several units, but not entirely satisfied with them, were seeking a more suitable cycle and arrangement.

This company was primarily interested in finding an outlet for the manufacture and sale of their oil-fired steam generators. We, of the Davis Engineering Corp., advised them of our idea in which they immediately saw the advantages and it was decided that the two companies would collaborate on the development of such units; the Cleaver-Brooks Co. to handle the first effect oil-fired evaporator end and the Davis Engineering Corp. the second effect evaporator and distillation end.

The pilot plant was completed in August of 1941 and tested with sea water. This plant was designed to produce 100 gal of distilled water per hour and upon test delivered slightly in excess of the design capacity.

The plant consisted of an oil-fired first effect salt water evaporator, a second effect evaporator, distiller, condenser, distilled water cooler and animal bone charcoal filter. The oil burner fan and fuel pump and circulating water and evaporator feed pumps were belt connected to a small gasoline engine.

Endurance tests were convincing enough to the Navy Department to order two plants, each to have a capacity of 250 gal per hr.

In December, 1941, we were struggling with the problem of designing and building, in cooperation with Cleaver-Brooks Co., the first two plants of new design for shipment by the first week in January, 1942. Needless to say it was not all that we desired, but the plants worked and produced. These plants were mounted on frames and could be picked up by a crane all intact, and laid down anywhere on a shore base.

The Marine Corp became interested in our distilling plant. Then both the Marines and Army wanted plants mounted on wheels. Their requests were met and orders were placed for many plants.

Tests were continued and improvements made with one idea in mind; simplicity of operation. At one time it was thought advisable to have a cold water shocking line for rapid filling of an evaporator to crack off scale. The value of it as a scale remover when compared with the added duty for an operator resulted in removing the valve.

High temperature feeding proved to be very valuable in the early stages of our testing. This high temperature was obtained as a result of heating the cooling water, from which the feed was taken, to a temperature of 200 F. The operator had no difficulty in obtaining this high feed temperature. All he had to do was throttle the flow of cooling water until intermittent puffs of steam issued from the vent pipe of the condenser. It was surprising to note what effect there was on the rate of production if the feed temperature dropped 5 or 10 F.

Under ordinary conditions it was not necessary to observe the thermometer. On the other hand if the temperature dropped 20 or 30 F and steam blew from the vent, the indications were that the condenser had become fouled.

An operator should always be able to tell at a glance what capacity the plant is producing. That information can be obtained from a weir, for it acts just like a speedometer. A weir, having the form of a T slot cut upside down in the side of a cup, was developed for these plants. The height of the water flowing through the slot was a direct measure of the capacity being produced. The cup was simple in construction and could withstand rough usage.

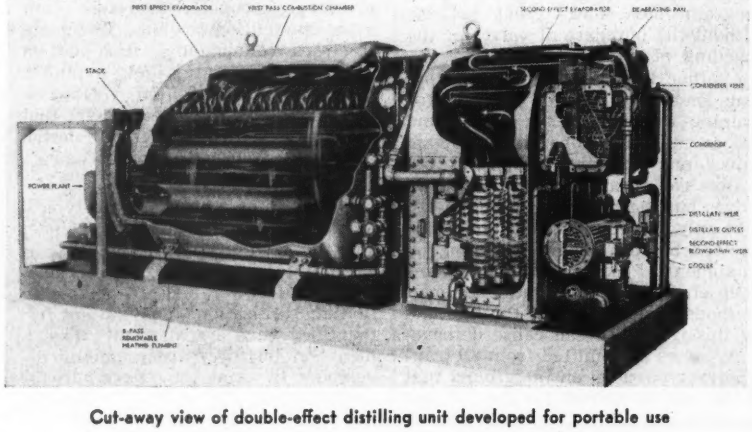
The condenser being designed to produce a high cooling water outlet temperature accomplished two things; it reduced the quantity of cooling water to be pumped and it made it possible for the plant to work on a small pond or a well having a limited flow. The actual amount of cooling water required was only 6 gal for each gallon of distillate. Compare this with the conventional single effect plant which requires anywhere from 20 to 40 gal of cooling water per gallon of distillate.

Salt water evaporation produces a concentrated brine. The degree of concentration has an effect on the output of a plant. The lower the concentration the better. The test made at Fort Storey showed that if ordinary sea water, containing 3 per cent of salt, was doubled in concentration good results could be obtained. Hence, by maintaining a blow-down rate equal to the rate of production of distillate the proper density within the evaporator shell could be maintained. That is, for every gallon of distillate two gallons of sea water must be fed to the boiler, one gallon of which passes off as blow-down. Thus it was only necessary to add another weir cup to the blow-down line of the same size and shape as the weir in the distillate line. All the operator had to do was to check the flow through each weir to see if the height of the water in each slot was the same.

Certain improvements were made in the overflow piping, controlling the height of the water in the evaporator shell. The major part of the piping was set up inside the evaporator so that the blow-down water was taken from a level near the bottom of the shell. The device worked so well and the principal of operation was so sound that it became apparent that a similar piece of piping could be applied to the boiler. The device was no more than a water trap. With proper proportioning of the piping, the height of the water in the boiler could be automatically maintained. Thus, by the simple control of one valve both evaporators could be fed a sufficient amount of sea water and by adjusting the opening of the valve, a proper rate of blow-down could be established.

Many of the features embodied in these portable distilling plants could very well be applied to existing water distilling plants or to those yet to be built.

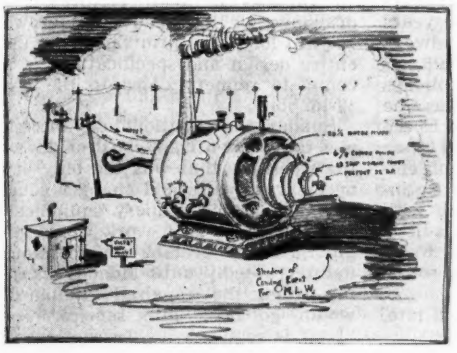
* Abstract of paper presented at the Annual Meeting of the A.S.M.E., November 30, '44.



Cut-away view of double-effect distilling unit developed for portable use

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR



The Shape of Things to Come

Motor manufacturers no doubt have their own ideas about what post-war motors are going to look like but we feel that the design shown in the accompanying drawing deserves their serious consideration. It happens to be an artist's conception of a post-war motor and while somewhat unorthodox one must admit it has about everything that could be desired, including a tale.

The tale is as follows: The artist's brother who has a well-equipped basement workshop is in need of an electric motor to operate one of his power tools. So the artist, whose name is Ralph, decided to give Malcolm (M. L. W. on the drawing) a motor for a birthday present. When he tried to purchase the motor, however, he discovered that there were such things as AA-1 priorities and not being equipped with one of these necessary evils, he came away empty handed. To show his good intentions, however, he presented Malcolm with a drawing of the motor he would get for him some day. We happened to run across it quite by accident and were so intrigued by its many astonishing features that we decided to let the motor manufacturers in on it.

As we see it, one of the most useful features about this motor is the smokestack. Most motors, when they start to get hot, start to smoke and it is very untidy to have the smoke issue from all parts of the winding. With this design, all the smoke comes out of the chimney. Like all simple things, we wonder why somebody has not thought of such an arrangement before. No, the design is not patented. A. W. K.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

A Good Engineer Steps Down

By ANDREW W. KRAMER

IN AUGUST 1939, shortly after the Practical Engineer section was inaugurated, there appeared in its pages, a short article entitled, "A Man and His Work". This was the story of Dan Gutleben, engineer *par excellence* and dean of the sugar house engineers in this country—the plant engineer of the Pennsylvania Sugar Company in Philadelphia. His name was a by-word in the neighborhood of Shackamaxon Avenue and the Delaware River.

A great many things have happened in the world since the publication of that article about Dan Gutleben but one event that is bound to affect the organization of the Pennsylvania Sugar Plant is the absence of Dan Gutleben from his long drafting table in the Engineering Department. After 24 years of 7 days a week on the job, Dan Gutleben relinquished the old job at the refinery on December 31st of last year and, as he characteristically phrased it, has taken the status of "Old man Gutleben."

Only those of us who know him personally can realize what this means both to him and the company. With only 5 days for sick leave in twenty-four 365-day years, Dan was almost more of a landmark than the refinery itself. The refinery underwent many changes during the years but Dan Gutleben remained always the same—calm, efficient, good natured and ever helpful. On holidays —Thanksgiving and Christmas—he would come down to the plant to see how things were going and then drive around to the homes of employes who were ill or otherwise incapacitated to cheer them up with his homely philosophy and with little gifts. He was never too busy to do a good deed or to be of help to somebody in need.

He was on the job early and late, not because he drove himself but because he loved his job. Though he exhibited a wide interest in other things, his one and all-consuming passion was the refinery and sugar engineering. He not only operated refineries but he designed and built them. He could lay out the steel for a refinery or sugar mill as easily and effectively as he could design a steam power plant. He was among the first in this country to install a large steam accumulator in connection with his boiler plant. No visitor who ever came into the engineering department failed to register surprise and enthusiasm over the famous Gutleben "Log" that great compendium of humor, philosophy and engineering information covering over 40 volumes of text, pictures and drawings, or his beautifully drawn 10-yard long blue prints showing the entire design and specifications of a complete refinery down to the last ½-in. bolt.

Sunday, the traditional day of rest, was quite often Dan's busiest day of the week for that was the only day necessary repairs and changes could be made in the refinery equipment. In many cases such work would begin Saturday evening and continue uninterruptedly until Monday morning when the repaired equipment would go back into service. The "Log" is replete with descriptions of

JUNE 1, 1938

FLOORS

Repairs Under Fermenters Nos. 3 & 4

The floor was subjected to the attack of H_2SO_4 leaking from the acid towers, pumps and piping of the CO_2 purification system. The cause of this was a combination of poor design and indifferent housekeeping. Furthermore, the floor did not have sufficient pitch and thus prevented depressions from draining. If a floor could be perfectly graded, a slight pitch would be sufficient. The original concentrate floor (1924) was repaired in 1928 (See Log, Oct. 2, 1928) [July 16, '29] using a mastic floor specified as "Lifekote Specification 2" and made by the Union Products Company. This could not resist the acid and began failing in a short time. It was condemned several years ago but suffered to remain thus long because we "couldn't get around to it."

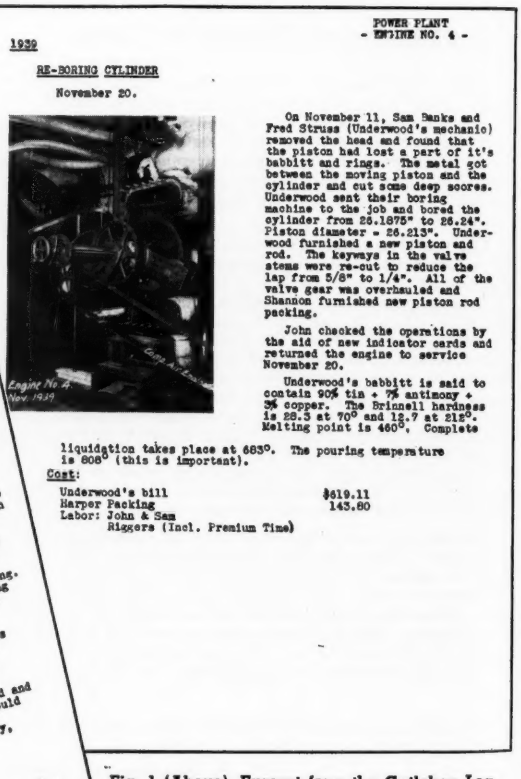
At the fermenter columns the floor had been made higher to drain the acid spillage away from the steel, but the acid soaked thru the mastic and attacked the steel "like a thief in the night". The extent of the damage was not suspected till we removed the mastic to make repairs. The photograph shows the worst of the columns of which there are eight under each fermenter. Eleven were damaged and were repaired by welding 1/2" bars 15" long on the flanges and webs. The picture of May 20 shows one bar tacked on one side of the web. 1/2" spaces were left between the bars and filled by welding. The column so as to allow metal left at 10.5.

The old concrete floor was chipped down to suit a new grade to three additional floor drains. The new floor was made of 1:1:1 mixture of early strength Portland cement, pure coarse silica sand and pure silica gravel mixed with the least quantity of water that would allow the mixer to discharge. One half gallon of Master Builder Company's "Master Mix" was added per bag of cement. Incidentally,

The concrete was cut away all around the column so as not more than 1 1/2" on uninjured metal. There was not more than 1 1/2" of the deteriorated section of the column against the periphery columns to the center one The load has shifted from the periphery columns to the center one (See Log, Oct. 1, 1937 for drawing of fermenters. The house columns were not affected by the acid as these were covered with concrete.

- 1 -

Column fermenter #3 June 1 1938



POWER PLANT
- ENGINE NO. 4 -

1939

RE-BORING CYLINDER

November 20.

Engine No. 4 Nov. 1939

On November 11, Sam Banks and Fred Struss (Underwood's mechanic) removed the head and found that the piston had lost a part of it's babbitt and rings. The metal got between the moving piston and the cylinder and cut some deep scores. Underwood sent their boring machine to the job and bored the cylinder from 26.1875" to 26.24". Piston diameter = 26.213". Underwood furnished a new piston and rod. The keyways in the valve stems were re-cut to reduce the lap from 5/8" to 1/4". All of the valve gear was overhauled and Shannon furnished new piston rod packing.

John checked the operations by the aid of new indicator cards and returned the engine to service November 20.

Underwood's babbitt is said to contain 90% tin + 7% antimony + 3% copper. The Brinnell hardness is 28.3 at 70° and 18.7 at 212°. Melting point is 460°. Complete liquidation takes place at 663°. The pouring temperature is 808° (this is important).

Cost:

Underwood's bill	$619.11
Harper Packing	143.80
Labor: John & Sam Riggers (Incl. Premium Time)	

Fig. 1 (Above). Excerpt from the Gutleben Log describing a repair job of one of the engines in the power plant

Fig. 2 (Left). Everything was recorded in the Log. Here is an item describing a floor repair

such repairs and always there are photographs showing exactly what was done. Dan's camera was just as much a part of his engineering paraphernalia as was his slide rule. Typical illustrations taken from the "Log" showing how such repairs were recorded are shown in Figs. 1 and 2. The engine repair is common enough but the floor and column repair in Fig. 2 indicates the scope of the activities carried on under Dan's direction.

There were always special problems that had to be solved; some simple, others very difficult. A simple one is shown in Fig. 3. In this case it was necessary to illuminate the sugar bins. As shown, this was done by reflecting the light from a lamp by means of a stainless steel reflector set at the proper angle. Stainless steel was used to avoid the risk of contaminating the sugar with glass. Note the cost.

As a good engineer, Dan Gutleben never lost sight of the cost of things. Whether the work involved the installation of a lighting box such as the one shown at a cost of a few dollars or the installation of a huge conveyor for unloading the ships which tied up to the dock at a cost of $50,000, every item of expense was always listed down to the last cent. While the cost of operations were large, no money was ever wasted. True, mistakes were made at times but they tried to accept them as they came and endeavored to profit by them. "Everbyody makes mistakes," said Dan, "and thereby adds to his stock of experience."

The interesting thing about the items in the "Log" is that they always combined important facts with human interest.[1] There was always some little human angle that made the account, whatever it might be, more interesting. Take for example the report on Drinking Water Fountains, dated August 8, 1937. In 1929 a plan was laid out for a drinking water supply. The estimated cost was $10,000 for 42 drinking fountains This is a lot of money for a mere item such as drinking fountains but it was fully justified on the basis of savings made in the purchase of ice. By 1937, thirty-two of these fountains had been installed at a total cost of $6163.09. As the report shows, however, in 1925, they had purchased 474 tons of ice at $86.00 per ton or a total cost of $4000. In 1936, after 16 of the drinking fountains had been installed only 225 tons of ice were used. Even though this ice was bought at $38.00 a ton compared with $86.00 in 1925, it still came to a total of $850.00. "The standard unit," the report states, "is a Hires PB-12. This unit is equipped with a bubbler, a 1/3 hp motor and has a capacity of 10 gal per hr. For the Rectifying plant and Rum Distillery, *explosion-proof* motors are used. Sanitary bubblers replace the old drinking cups, but the Polanders can't break old habits too suddenly. They still use cups and milk bottles. At the dock, the first cooler (1929) was overloaded by the use of cups and buckets. . . . Ray reports a reduction in heat prostration—which may be due to some extent to better ventilation and shorter work days. Salt tablet dispensers have been installed near the fountains to comply with a brainstorm that was recently let loose. The first one was installed on the shipping floor for the benefit of the truckers. The next morning the cover had been knocked off and the tablets were gone! . . . Drinking water fountains should be located where men have business to be. The place should be open—along the main aisles. A location in a blind alley or in front of a popular conversationalist (like Hank Dempsey's tool room) promotes congregation under the protection of a good alibi in case the boss happens by. Time-wasting conversation isn't comfortable in a conspicuous place. . . . When the old 'inverted bottle' style of coolers were discarded, Elmer Jones salvaged one and converted it into a root-beer dispenser. He used one package of Hires concentrated ingredients + Quaker sugar and mixed therein some broken dry ice. The dry ice cooled the liquid and was thought to impart some pep. It could not pass through the spigot into the cup. Elmer's office acquired popularity and everybody in the place found it frequently necessary to consult him in his office. There was an increased demand for his telephone."

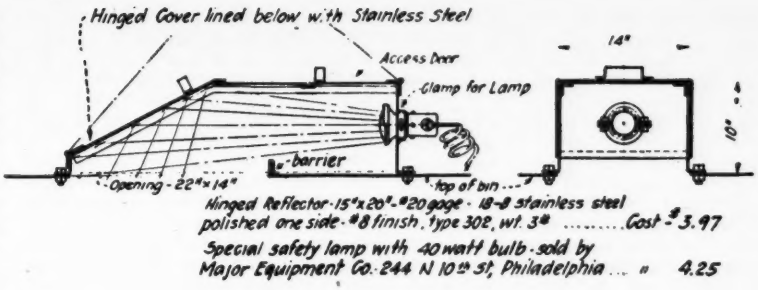

Hinged Cover lined below with Stainless Steel
Access Door
Clamp for Lamp
14"
barrier
Opening - 22"x14"
top of bin
Hinged Reflector-15"x20"-#20 gage - 18-8 stainless steel polished one side-#8 finish, type 302, wt. 3# ..... Cost - $ 3.97
Special safety lamp with 40 watt bulb-sold by Major Equipment Co. 244 N 10th St, Philadelphia ... " 4.25
Sugar bins are illuminated by light reflected from stainless steel mirrors to avoid the risk of contaminating the sugar with glass.

Fig. 3. Showing an arrangement for illuminating a sugar bin by reflected light

Fig. 4. The famous Gutleben exercise chart

The Gutleben Log was open to anybody who cared to look at it, even technical paper editors. Upon one occasion the writer was interested in an item in the log and asked for permission to publish it. A memo to "Bro. Kramer" came in the next mail. "There isn't anything in my log that is a secret, except now and then I take a wallop at some dam fool union business agent but that stuff is kept in another book! . . . Many hundreds of pages leave my log for distribution among the boys where they can do some good."

The Log was a veritable gold mine for visiting editors. As Dan quietly put it—"The latch string is always on the outside to you boys." Whenever we came in, he would make us welcome, haul out the latest volume of the Log, sit us at one of the drafting tables or a desk and let us go through it. Anything we wanted, we would note, and quite often, extra blue prints of the pages we selected would be ready before it was time for us to leave. If we were there during noon hour, Dan would come in and toss us one of two red apples he had and we would have lunch. This was the only lunch he ate for years.

Dan Gutleben is an insistent upon the proper care and maintenance of his body as he is of his sugar refinery. Some years ago, in the January 1941 issue to be exact,[2] contrary to the established rules of technical paper editing, we published the famous Gutleben exercise chart. This chart, which looks like a page from Sherlock Holmes' Mystery of the Dancing Men, is an engineer's idea of how to keep fit. By means of

[1] See "The Nightmare of Nicodemus and Related Subjects." Power Plant Engineering, p. 726, November, 1939.

[2] The Maintenance of Practical Engineers, page 70, January, 1941.

simple single line human figures, this chart describes a series of exercises selected, mostly from the Military Manual, which are bound to keep one fit, if taken regularly. They take about 15 minutes to perform and Dan says it is desirable to perform them in the nude before an open window, Winter and Summer. We have Dan's word for it (and this is all we need) that he performs them every morning. "To install a systematic drill into a daily routine," he points out, requires discipline, which is to the will what the contortions are to the muscles."

Practically all of the writing on the Log was done at night, at home. Upon leaving the plant in the evening he always carried a brief case full of data to work on at home. In 1942 when his brief case went the way of The One Horse Shay, the following item appeared in one of Dan's mimeographed letters to the sugar fraternity.

"My old leather brief case, Christmas gift from Cap Loveland, cannot be replaced without an A-1-j priority rating. I have however a substitute that exceeds the leather in efficacy. I use the large manila envelopes that come through the mail. Its structural capacity limits its cruising radius, but for the 5-mile shuttle on the subway from the office to the home desk, it serves perfectly and besides provides space for recording the thoughts that evolve while traveling from hither and yon. Currently I am using one that came from Fred Gibson. When both sides are filled with doodles, the morning mail yields a new envelope."

Those fortunate mortals who were on the mailing list, always enjoyed the annual "Dear Harry" letters which Dan sent to some 200 "sugar tramps" throughout the world. This letter, which sometimes involved 33 single spaced typewritten sheets was devoted to reminiscenses and news of the sugar tramps, stories about their work and experiences and information as to their whereabouts. It was addressed to Harry who symbolized the sugar tramp throughout the world. About once a year Dan would take a few weeks off to travel in distant parts to see what the boys were doing. In between, he carried on a vast correspondence with sugar engineers, the substance of which usually appeared in the Dear Harry letters. All of it furnishes the material for a book which Dan has been working on and which, now, he can devote all his time to—a history of the sugar industry in this country. As he expressed it in his valedictory letter last January, "As to plans for the future, I propose to spend a few months at the great Ware sugar library at the Franklin Institute and then return to the old homestead in San Francisco. There are some gaps to be filled up in the 'travels of the tramps.' Our industry, past and present contains men of amazing qualities and I have a desire to expose some of these for the edification of the tribe. It is difficult to extract the facts by mail and so it may be necessary, when traveling can be resumed, to seek out the tramps in their lairs and sit with them on the bench."

So, while Dan Gutleben is retiring from active duty at the refinery, he is by no stretch of the imagination going to loaf. His retirement merely gives him an opportunity to take things a little easier and to pursue more effectively the writing which he has had in mind for so many years.

"Last spring," as he put it in his last Dear Harry letter, "I sensed a slackening of agility and enthusiasm and so I decided it was time to give notice. I have on several occasions had the distressing experience of succeeding an old man who hung on till his nerves and head had been incapacitated. Twenty-four years of 7-day weeks on a line job with the relentless urge for the daily maximum of production can develop drudgerous reactions. With old age stealing up, the confidence in the good right arm diminishes and doubts and concern have a habit of coming up in the middle of the night. A man ought to step down before his vitality is gone and his arteries become ossified. Anyhow, thanks to Lt. John J. Pershing and the quarter hour daily setting-up exercises that he inaugurated at Nebraska University in 1894, the time keeper has charged against me only 5 days for sick leave in twenty-four 365-day years. The 'House' provided a most fascinating job and paid me for it! Henceforth I shall be relieved of the restrictions of a gainful occupation."

Back to the old homestead in San Francisco

Modern HRT Boiler Plants

Those who by virtue of their training and background still favor the hrt type of boiler need not discard this type when their old units wear out. Modern types of hrt boilers are available which give excellent service and, with proper automatic firing equipment will give boiler efficiences as high as 75 per cent

By GEORGE A. AIKEN

THERE ARE still a great many plant owners and engineers who retain their faith in hrt boilers. These are usually the men who have operated boilers of this kind for many years and who feel, that because the boilers have operated satisfactorily, there is no need to change to some other type. In plants where such boilers are old and where they are no longer able to carry the required 150 or 160 lb. pressure, and particularly in plants where new equipment must fit into the existing boiler room, the latest types of hrt boilers are available.

These new type boilers are capable of generating much larger amounts of steam than the older boilers of the tubular type. They have self contained water-cooled furnaces which reduce furnace maintenance to a minimum. The use of water-cooled walls is also of advantage in that, in many of these units, half of the total steam produced by the boiler is produced in the water walls. Such water-cooled furnaces are adequately justified by the savings in fuel and the reduced cost of maintenance of furnace and stoker parts where the latter type of firing equipment is used.

The type of water wall used in these boilers is simple and very effective. The tubes are spaced a small distance apart and located in front of a refractory wall, which they partly screen and from which the rear of the tubes receive reflected heat. The outside of the boiler is covered with a metal jacket or lagging.

Superheaters

There are a number of types of superheaters that are well suited for this type boiler. One type consists of from 4 to 8 tubes, which are simply strapped around the boiler, and may be installed without changing the setting or arch. So located it absorbs both convection and radiant heat to give a very desirable flat, superheat temperature characteristic. In another type, the pendant type, the elements are dropped from the rear arch. This type is also easily installed and gives very desirable operating results.

The real value of superheat lies not in its effect on boiler efficiency, but on the steam heat cycle and prime mover efficiency. For example, the use of 100 F of superheat instead of saturated steam will save from 18 to

20 per cent for a simple engine. Of course, the saving is due mostly to decreased cylinder condensation losses, although small heat losses in piping, valves and throttle are still further decreased. This steam savings help towards further economies in reduced feedwater treatment required and lighter boiler loads.

Economizers

It is generally held that one per cent of the fuel bill is saved for every 30 F decrease in stack temperature resulting from some type of heat recovery equipment. Although the installation of such equipment may involve considerable expense, a very good financial return may result.

Good savings are possible by installing an economizer with this type of boiler. The economizer may be installed directly over the front of the boiler in a cross-wise direction, thereby absorbing a large amount of the heat before the gases enter the breeching and stack.

They have convenient doors which give ready access for cleaning the tubes or removing them. They save fuel by recovering waste heat from the flue gases, besides increasing the capacity by delivering hotter feedwater to the boiler.

Stokers

The average hand-fired boiler operates at from 40 to 50 per cent efficiency, depending upon how it is fired; the human element in firing influencing the rate of fuel consumption. The only way to get a fair efficiency with hand-firing, is to give constant attention to the boiler; usually impossible. Coal is usually thrown in on the fire in large quantities and air holes form in the fuel bed that permit excess air to enter, causing inefficient combustion.

The stoker-fired boiler has the advantage of regulated coal supply, coal being fed to the fire as needed with necessary oxygen introduced into the burning fuel as needed, instead of depending on the chimney draft as in hand-fired jobs.

Because the gases are released slowly by stoker-firing and delivered at varying favorable temperatures for combustion, stoker-firing efficiency frequently is as high as 75 per cent. However, because the load on the boiler and the manner in which the stoker-fired-boiler combination is operated determines the efficiency, the average stoker-fired jobs are figured conservatively as about 65 per cent efficient. This added efficiency over hand-firing represents fuel economy and more economical use of the boiler.

We can illustrate the savings through stoker-firing compared to hand-firing by an example. If we burn 14,500 Btu coal at 50 per cent hand-fired efficiency, we use 7250 from each pound of coal. Burning 14,500 Btu coal at 65 per cent stoker-fired efficiency, however, we use 9425 Btu per lb of coal, a gain of 2175 in heat recovery. In terms of fuel savings, therefore, the higher the efficiency we obtain the lower the fuel losses; the more water evaporated per pound of coal consumed.

Before deciding on which stoker to buy, consider the fact that the cost of the coal you burn in a single year will greatly exceed the cost of the stoker. Since the life of a stoker should be at least 10 to 20 yr, it is self-evident that even slightly better overall performance will offset any likely difference in the first cost between the best and the cheapest stoker.

Some of the small single and double retort stokers are designed and built to provide large stoker standards of performance.

These may have features such as a steel coal hopper holding from 1000 to 2000 lb of coal of heavy welded construction of rust and corrosion resisting material. The coal feeding mechanism may be of the worm or ram construction, or a combination of both. The units also may have stationary or moving grate bars and rear or side ash dumping grates of high heat resisting metals.

The stoker drives are compact and may consist of either motor or turbine. They may include an integral forced draft fan and be equipped with adjustments providing a large number of rates of coal feeding. The average stoker usually consists of a retort, fan, transmission, air duct, air control, hopper, ram or feed-screw. The large majority are driven by electric motors, either connected directly or through V-belts to the transmission. There should be an overload relay for motor protection and shear pins to protect the driving mechanism against damage when foreign matter in the coal puts excessive strain on it. The transmission rotates the screw or ram the number of revolutions or strokes per minute, as determined by the number of pounds of coal required to maintain the steam pressure and the load. Where all the exhaust steam may be used, a steam turbine may be utilized, thus giving a variable speed control.

A stoker increases the efficiency of the boiler by increasing the rate of combustion, thus releasing a more constant heat to the boiler heating surfaces, but it does not cure overload conditions. Every boiler has a peak in efficiency in proportion to its heating surface, and a stoker does not

"I could fix it in a jiffy if I only had a hairpin"

add additional heating surface. Normally little difficulty in obtaining high operating efficiency will be experienced if the stoker is of generous size.

Most troubles with clinkers, blow holes, burned grates, low CO_2, etc., are due to undersized stokers, which must be forced beyond their reasonable capacities in order to handle the load. In such cases the cost of stoker iron per ton of coal burned, is most assuredly going to be high.

Because firing rates vary with the varying demands for heat or power during a 24 hr period, stokers should have a reserve capacity for peak load demands. The maximum load to be placed on a boiler determines the size of the stoker to be selected, but even with the right size and capacity, the stoker cannot always perform efficiently without the right size and grade of coal.

Stoker Controls

A simple automatic stoker control equipment for a small stoker-boiler installation, might comprise of the electric start-stop type actuated by the steam pressure high or low, or 2 speed controls, high and low water, overpressure, hold-fire and banking controls. The start-stop controls are widely used because they are simple, reliable and flexible. They sometimes consist of a mercury switch actuated by the steam pressure, wired through switches, relays, etc., to the motor driving the stoker and forced draft fan. The high and low speed control, regulates the amount of fuel burned by a mechanical adjustment of the variable speed transmission on the stoker drive.

Certain instruments should be incorporated to guide the operator in making the necessary adjustments, when fuel or load conditions change. It is advisable to have furnace and uptake draft and undergrate draft gages, a steam or water flow meter, a recording or indicating CO_2 meter and a stack temperature gage. After the operator becomes familiar with the use and advantages of the meters and gages, he will be able to maintain close to maximum efficiency of the boiler and the furnace.

A good reliable boiler feedwater level regulator is a must; besides two or more proper sized boiler feed pumps. Have your feedwater problems taken care of by one of the thoroughly reliable firms who specialize in feedwater control. All of which should give you a hrt boiler plant that should be economical, efficient, and also having a good continuity of service record. And should also give a lot of satisfaction when showing the plant to visiting engineers.

The services of an experienced consulting engineer, should be included when thoughts of post-war modernizing are considered. Their judgment and experience will help to prevent the new plant from accumulating some of the headaches and backaches, and should also give you more trouble-free days and nights.

Carrying Out Feedwater Treatment Tests

By Charles W. Parks

THE SUBJECT OF feedwater treatment has been thoroughly treated many times before but the method of carrying on the various tests involved cannot be too well emphasized. The results of feedwater treatment are only as good as the man who makes the tests, mixes the solution tanks and regulates the blowdowns. In many instances this is carried on very well but in other instances it is more or less a hit and miss procedure. The chemicals used in feedwater treatment are expensive and at the present time not too plentiful. If used carelessly, it means loss of money and valuable material and if used too sparingly, results in needless boiler cleanings and repairs. When feedwater treatment is carefully managed, however, as it should be, it is a money saving investment. It has been my experience in the past that the job of running tests is shoved off too often on some disinterested and inexperienced person or group of persons. These people, in all probability do not know anything about the subject but are just broken in as what to do, to follow the instruction sheets step by step or both and as a result, they never realize the true value of making careful tests and readings.

The running of feedwater tests, should be as near as possible, in the hands of one man. This man should be thoroughly versed on the subject and should be a serious, reliable and capable person—one who can be trusted to work behind your back as well as when he is being observed. This is the job for a young man with some elementary chemistry background. If he does not possess it, he should be schooled until he thoroughly understands his job before it is turned over to him. He should be interested in the work because if he is not, he will never make a success of it. Very often the chemicals used and the system of injecting them, do not receive full credit for what they can do, simply because they have not been properly handled.

Costs of these treatments are, in many cases, much higher than they were supposed to be. This is because the job has been handed to some disinterested person who does not like the job and doesn't understand it. Very often the results of these tests do not make a good showing while the report sheets show a splendid condition. Such reports are often falsified when no actual tests were ever made.

The condition inside of a boiler can change very rapidly and careful and accurate tests must be made in order to determine the proper amount of chemical to be added. The water used in the boilers should be analyzed by a reputable company, specializing in the treatment of boiler feedwater. Such an organization will advise the correct treatment for that particular water and condition and will indicate the best injection method. Under no circumstances, should one attempt to treat feedwater without first having it analyzed and the correct chemical prescribed because what will be correct for one water, may be harmful to another.

Select the right man for the job of running the tests. Select a man who is interested in the subject preferably some young fellow who has had or is taking some elementary chemistry. This man should be given the best of material with which to work and should have the cooperation of both the department heads and the operating personnel. He should be in charge of the manual and continuous blowdown systems and he should be supplied with fresh chemicals and supplies. He should have a good, well lighted room in which to make his tests and keep his supplies. Work order pads should be provided so that he can report any leaky valves that he may discover and any other conditions that need attention pertaining to his job. These orders should receive prompt attention. Remember, he cannot do a good job if his chemicals are blowing down the sewer pipe. Lack of cooperation will cause him to lose interest and cause him to become careless. His work should be checked from time to time when he least suspects it so that he will know that his work is being closely watched.

First of all, follow the instructions given by the chemical company to the letter. Keep them posted for ready reference. Whenever in doubt, call or write the company's representative for help or instruction. Never allow your equipment to become dirty. Keep everything as clean as possible to do so. Always wash the test tubes and flasks very carefully after every test. Don't allow water from one boiler test to become mingled with that of another. Be exact in the taking of readings and in measuring. Don't trust to memory. Write everything down as you take it. Be careful not to allow solution tanks to run over as this weakens the solution. Always keep the solution tanks well stirred and clean. They should be drained and cleaned once in a while as the sediment will clog valves and pipe lines. Don't order stock too far ahead as it tends to get stale. Always have fresh stock. Report any leaky valves or other conditions that need any attending to. Be sure that the operating personnel is constantly advised as to the operation of the blowdowns and changes well posted. If the above precautions are carefully carried out, the results will measure up accordingly.

Measuring the Speed of Moving Parts without Contact

IN THE INSPECTION and maintenance of power plant equipment or any mechanical equipment used in industrial plants it is often desirable, if not essential, to know the speed at which such equipment may be operating. Various types of tachometers have been available of this purpose for many years and while these tachometers are accurate and useful, often it takes some effort to apply them. This is particularly true where the moving parts are not readily accessible.

This is where a small device known as the "Strobomeca" comes in handy because with this instrument, the speed of any rotating or reciprocating part of a machine can be measured from a distance with no actual contact whatever with the machine itself.

The Strobomeca is an exceptionally light, flexible and compact stroboscope for measuring high, medium or low cyclic speeds *from a distance* and *without contact* with moving objects. Its operation is extremely simple.

A rapidly rotating, vibrating, or reciprocating object, seen very briefly at the same point once each cycle, appears to be motionless because, each time it is briefly viewed, an impression, made upon the retina of the eye, is transferred to and retained by the brain until the next glimpse. This phenomenon known as the "persistence of vision" is utilized in the Strobomeca by frequently interrupting the path of vision between the moving object under observation and the retina, by means of a rotating slotted disc. Synchronization, or "interruption" at the same rate or at a multiple of the same rate as that of the moving object permits apparent immobolization of the object and accurate speed measurements.

The Strobomeca consists of a springwound motor driving a slotted disc, the speed of which is accurately controlled by a spring governor adjusted at will by imparting a clockwise or counterclockwise motion to the section of the housing which acts as a brake or release, as desired. The motor, wound by a permanently attached key, the disc, protected by a heavy glass panel, and the governor are contained in a three piece threaded aluminum housing. This housing bears a dual range metallic dial and a sturdy pointer, both designed to permit precise indication. An eye piece permits sighting through the slots of the disc and synchronization with the rotating or vibrating objective.

No Longer Than a Baseball

Slightly larger and heavier than a baseball, the Strobomeca cannot be conveniently carried in an average pocket, but it measures only 2⅝ in. in length by 2¾ in. in diameter and weighs only 11 oz.

The instrument is self contained, requires no electrical outlets, connections, current, wiring or transformers and can be used wherever motion is clearly visible. Unlike other stroboscopic tachometers it can be used in bright sunlight as well as under artificial light. Its usefulness is not dependent on bulbs, neon lights or batteries and it is not subject to wear due to thrust pressures and heat generated by high spindle speeds.

Like any other stroboscope the Strobomeca "stops motion" i.e., it causes rapidly rotating or vibrating objects to appear to be standing still.

The instrument is applicable to a wide variety of conditions of which the following are typical:

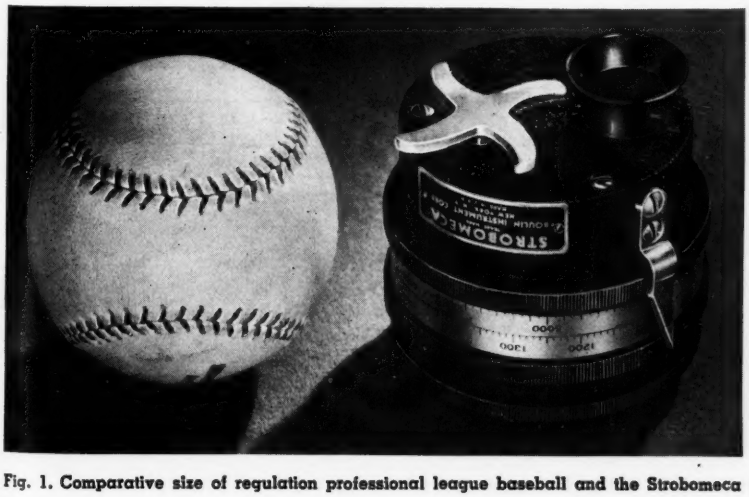


Fig. 1. Comparative size of regulation professional league baseball and the Strobomeca

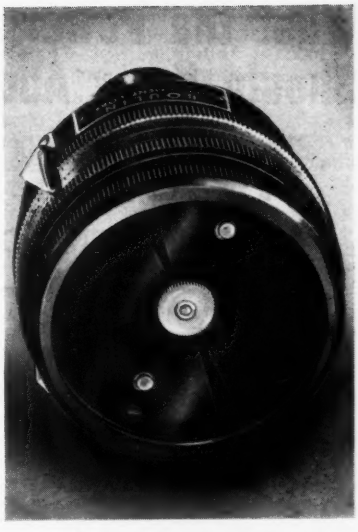


Fig. 2. A heavy glass cover protects the mechanism

Where objects to be tested have no accessible shift ends, such as drills and governors. Where objects to be tested are not easily accessible; such as blowers, airplane propellers, contact points, gears and springs in motion. Where the power of the objects to be tested is so low that light contact would cause a braking action; such as very small electric motors, fan or spinning motors. Where the speed of oscillating or intermittent movements is required; such as valve tappets, pneumatic hammers, vibrating screens, etc. Where speeds of a large number of moving objects must be determined or synchronized and controlled; such as in spinning, bobbin winding, cable braiding. The Strobomeca in such cases has proved to be 30 times faster than an ordinary mechanical tachometer. Where determination of high speeds is required it is safer to use this instrument than a contact tachometer as it is never in contact with rapidly moving objects.

In the power plant, an instrument should prove handy and convenient in checking the speed of forced and induced draft fans, centrifugal pumps and air compressors as well as of engines and motors. The fact that an instant determination of speed may be obtained without any preliminary preparations contributes to more frequent testing.

The instrument is made in two basic ranges, 500 to 8000 rpm and 1000 to 16,000 rpm or vpm. Its accuracy at any scale point above the first 15 per cent of either scale is within ±2 per cent of true speeds. Though made in two basic ranges it is not limited to these ranges. Either the 500 to 8000 or 1000 to 16,000 rpm models will measure speeds of 50 or less to 100,000 and more rpm, by using multiples.

The Strobomeca is made by the Boulin Instrument Company of New York, N. Y.

What the Power Engineer Should Know About

THE SLIDE RULE

By DENARD LEE GUSLER

CONTRARY to popular belief the slide rule is a very old instrument. It was in 1614, four years before the first permanent English settlement in this country, that John Napier of Scotland invented logarithms which later was the mathematical basis for the slide rule.

In Napoleon's time a simple form of slide rule was used to direct artillery fire. Then in 1859 a lieutenant in the French artillery, by the name of Manheim, invented the slide rule that bears his name and which, with certain improvements, is still used today.

It is not necessary to dwell at length on the benefits to be derived from the knowledge of how to use the slide rule. The fact that it is an essential part of all courses in engineering and mathematics speaks for itself. It is one of the most versatile, widely used tools, to be found anywhere and one that any engineer actively practising his profession cannot afford to do without.

If you are going to read this article you will get a great deal more out of it if you will first stop by the dime store and get a 25 cent slide rule. (Assuming that you have no rule.) Although cheap, this rule will be surprisingly accurate. As you read through each section, actually perform the indicated operation. You will find it easy, interesting, and a lot of fun. When you get to the part on trigonometry and rectangular to polar conversions, beg, borrow, or otherwise obtain, a rule that has the decitrig scales.

Shown in Fig. 1, a and b respectively, is a front and back view of a Keuffel and Esser, log log, duplex, decitrig slide rule. Don't be overawed by its 20 scales. We are only going to discuss those which are to

A simple form of slide rule was used in Napoleon's time to direct artillery fire

be found on most any rule. Obviously a discussion of all 20 scales is far outside the scope of this article but if the reader knows they exist he can learn about them and decide just what rule is best suited to his work.

Holding the Rule

First we will consider how to hold the rule. To position the slide grasp the stock lightly but firmly with the left hand using the right hand to grip the slide with the forefinger pressed against the stock. The slide is then moved with the forefinger of the left hand. When using the right index simply reverse your hands.

To position the runner, grasp the rule with both hands using the thumbs assisted by the forefingers of either hand. Practise doing this many times. It is the only way you can become proficient at the operations necessary when working problems.

Reading the Scales

The next and perhaps most important thing is how to read the scales. Any error in obtaining the answer to a problem will be determined largely by your ability, or lack of it, to accurately read the scales.

In Fig. 2 is shown the entire D scale which is the same as the C scale and the one you will use the most. It will be seen that the D scale is divided into 9 sections that are called primary divisions. They are numbered consequently from the left index which is 1, to the right index which is also 1, in the following manner: 1-2-3-4-5-6-7-8-9-1. Each primary division is divided into 10 secondary divisions which are numbered from the left index to 2 but are not numbered from 2 to the right index because of the manner in which each primary division decreases logarithmically from left to right. The secondary divisions are further subdivided by so-called tertiary lengths which are used in determining the third figure. The third figure may be determined very accurately from 1 to 2, with partial accuracy from 2 to 4 and will have to be estimated with the aid of the tertiary marks from 4 to the right index 1.

In Fig. 2 consider the location of the number 125. It is located on the rule at the point indicated. Now, here, is the important point. It doesn't matter so far as the rule is concerned

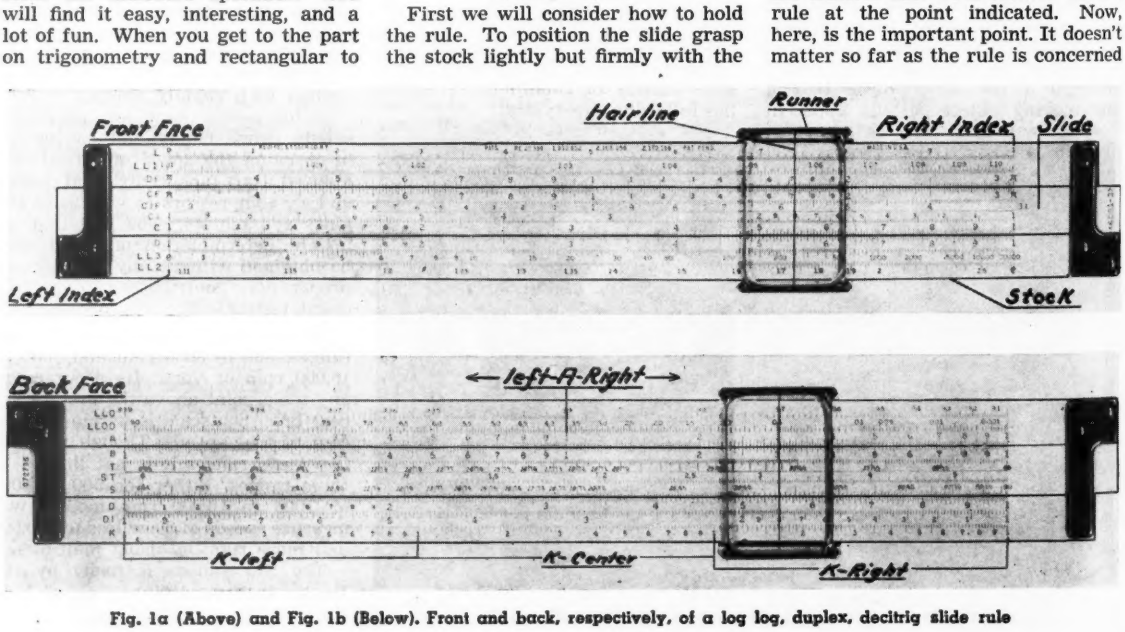


Fig. 1a (Above) and Fig. 1b (Below). Front and back, respectively, of a log log, duplex, decitrig slide rule

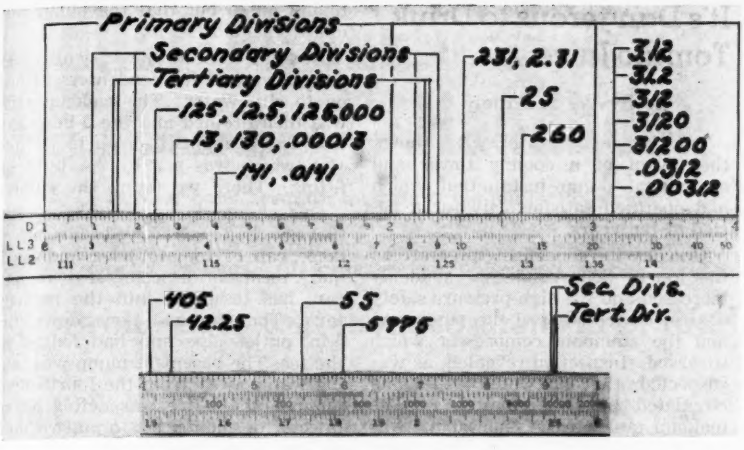


Fig. 2. View of the entire D scale

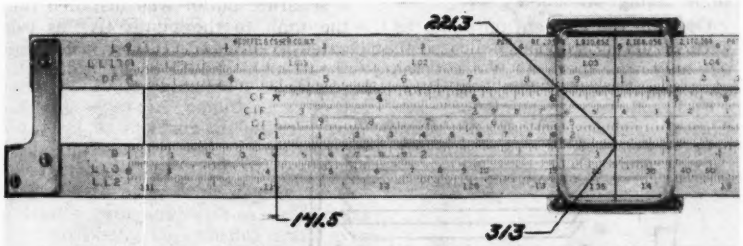


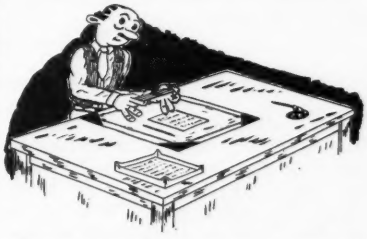
Fig. 3

where the decimal is located. Any number containing the basic figures 125 may be located at this point such as 125, 12.5, 125,000, .000,001,25 or 125,000,000. Do you begin to get the general idea? Consider the indicated location of 141. It can be any number that contains the basic figures 141. For example: .0141, 141,000, 1.41 and so forth. Also check the indicated location of the other numbers shown in Fig. 4. The methods of reading the scale will become increasingly clear as we start performing actual operations.

Multiplication

We will now use the C and D scales for multiplication. As we go along note the fact that the size of a number makes no difference. When using the slide rule it is as easy as 2 x 2 = 4.

First we will multiply 141.5 by 221.3. The left index of C scale is set on 141.5 on D scale and the hair line is placed over 221.3 on C scale. Under the hair line on D scale we read the answer 313. The resultant slide rule setting is shown in Fig. 3. The question now is how to locate the decimal and we are not going to do it by estimation but use an accurate method. We know that 141.5 x 221.3 may be written 1.415 x 2.213 x 10^4. Thus it follows that 313 should be written as 3.13 x 10^4 or 31,300 which is the true answer. I believe using the power of ten in this manner is the best method by which the beginner can locate his decimals.[1] Suppose we had multiplied 141,500 by 221,300,000. Then with exactly the same slide rule setting we would have 1.415 x 2.213 x 10^{13} = 3.13 x 10^{13} or 31,300,000,000,000. See how simple it is? Another example would be: .000,001,415 x .000,221,3 thus 1.415 x 2.213 x 10^{-10} = 3.13 x 10^{-10} =



Even the old timer can be converted to the use of the slide rule and the results are easy to see

[1] Editors note. A positive number can be expressed as the product of an integral power of 10 and a number between 1 and 10. Thus as given in the authors example:

141.5 may be written as 1.415 x 10^2
and 221.3 may be written as 2.213 x 10^2

Multiplication of two numbers having exponents such as 10^2 is effected by merely adding the exponents. Thus $10^2 \times 10^2 = 10^4$. Hence to multiply the two numbers shown above, we write them as shown in the author's example: $(1.415 \times 10^2) \times (2.213 \times 10^2) = 1.415 \times 2.213 \times 10^4 = 3.13 \times 10^4$. Since the number of digits in a number indicated by an exponent is always one more than the value of the exponent, in this case there are 5 digits in the answer. Hence $3.13 \times 10^4 = 31,300$.

If a number is less than one, the exponent is negative and its numerical value is one more than the number of zeros between the decimal point and the left-most non-zero digit.

Therefore .000,001,415 = 1.415 x 10^{-6}
Similarly .000,221,3 = 2.213 x 10^{-4}

Multiplying, we get

$1.415 \times 2.213 \times (10^{-6} + 10^{-4})$
$= 1.415 \times 2.213 \times 10^{-10} = 3.13 \times 10^{-10}$
= .000,000,000,313

The same principles are used in performing division but in division instead of adding the exponents, they are substracted.

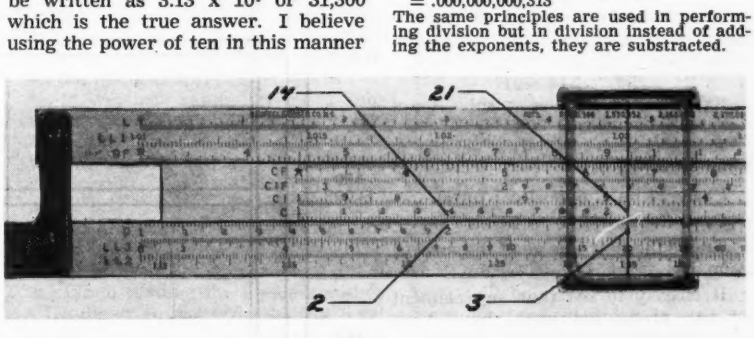


Fig. 6

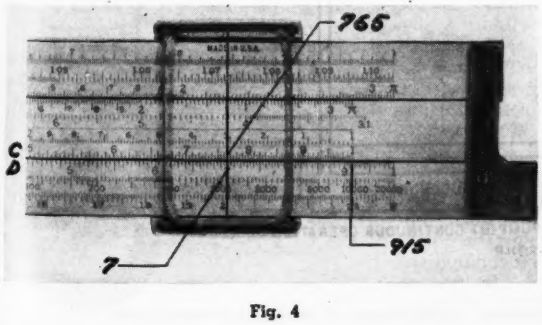


Fig. 4

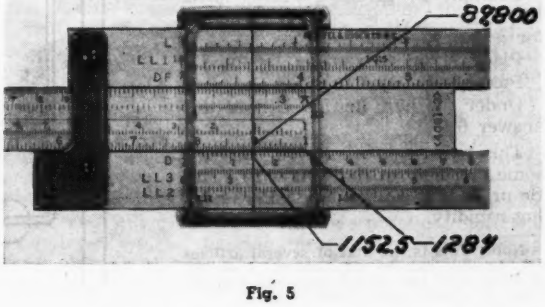


Fig. 5

.000000000313. If you don't think this is time saving get out some paper and try it the old way by long multiplication.

To multiply 915 by 765 we proceed as indicated in Fig. 4.

Set right index of C to 915 on D

Push hair line to 765 on C

Under the hair line read 7 on D

To locate the decimal $915 \times 765 = 9.15 \times 7.65 \times 10^4 = 700{,}000$

Division

We will also use the C and D scales for division. As our first example, suppose we divide 1152.5 by 89,800. The necessary slide rule setting is shown in Fig. 5. Obviously we have to estimate the location of the third figure of 89,800 and the fourth figure of 1152.5 but the results will be accurate to 1 or 2 per cent.

Set hair line to 1152.5 on D

Move 89,800 on C under the hair line

Under right index of C and D we read the answer, 1284

To locate the decimal:

$$\frac{11.525 \times 10^2}{8.9800 \times 10^4} = 1.284 \times 10^{-2} = .01284$$

ans.

Example 2: Divide 975 by .0023

Set hair line to 975 on D

Move .0023 on C under the hair line

Under left index of C on D read the answer 424.

To locate the decimal:

$$\frac{975}{.0023} = \frac{9.75 \times 10^2}{2.3 \times 10^3} = 4.24 \times 10^5 =$$

424,000 ans.

Ratio and Proportion

The C and D scales can be used to solve problems involving ratio and proportion.

Example: given $\frac{14}{7} : \frac{21}{x}$ solve for x

The necessary slide rule setting is shown in Fig. 6.

Place 14 on C opposite 7 on D.

Push the hair line to 21 on C.

Under the hair line read the answer 3 on D.

It is easy to see that any element of the proportion could have been solved in this manner.

Example 2: given $\frac{11}{156} : \frac{x}{85}$ solve for x

Place 11 on C opposite 156 on D.

Push the hairline to 85 on D.

Under the hair line on C read the answer 6.

This may seem somewhat cumbersome and slow at first but with a little practise it can be done with amazing rapidity.

Note: This is the first of several articles on the slide rule by Mr. Gusler. A second dealing with the actual solutions will appear in a subsequent issue.

It's Dangerous to Drink Tomato Juice

By W. E. Patten

THE ACCOMPANYING DRAWING shows the layout of a cooling tower and centrifugal pump installation which had operated satisfactorily for a period of ten years.

One day the condensing pressure on the fourth floor condenser suddenly increased and the high-pressure safety control device stopped the pump (A) and the ammonia compressor which it served. Inspection revealed, as was suspected, that no water was being circulated by the pump (A). The makeup tank on the floor above was full and pump (B) in the basement was operating normally except for a slight change in sound.

Opening the air vent on pump (A), with the pump stopped, indicated that not only was there no water coming to the pump but that the pump was under vacuum.

Next the cooling tower system was shut down and the condensers turned on to city water. The makeup tank was then drained and the 5-in. outlet line was dismantled down to the tee (C), which was a 3 by 2½ by 5 in. fitting. There we found the culprit.

One of our darling warehouse employees had self-served himself a large can of tomato juice and, as a quick means of disposing of the empty can, has tossed it into the makeup tank. The can had gone down the 5-in. outlet pipe and had lodged at the tee. The basement pump was taking water away from the fourth floor pump and the tee was acting as an injector or suction tee to pull vacuum on the fourth floor pump.

After the discovery of the trouble a separate outlet was installed from the tank to the pump (A) as indicated by the dotted lines, just in case the trouble should occur again.

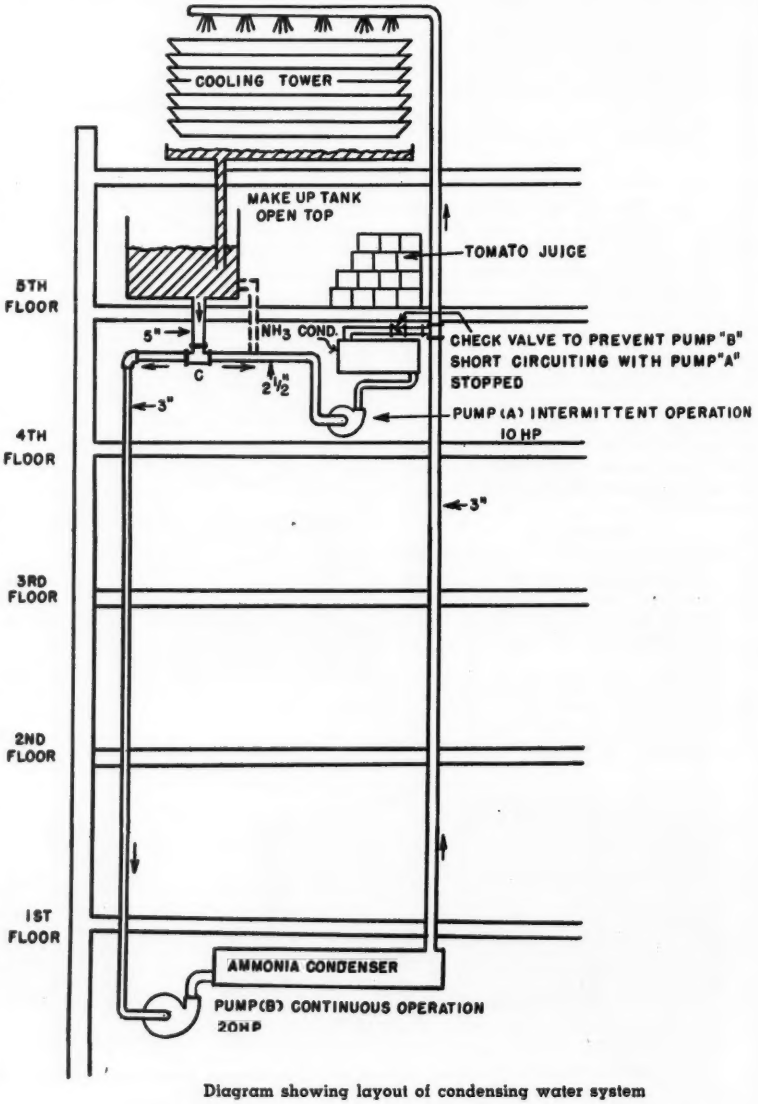


Diagram showing layout of condensing water system

Boiler Fireman's Handbook

By J. R. DARNELL

Further consideration regarding the subject of draft. Types of draft gages. Where and how to measure draft. Troubles that may arise in the operation of draft systems. Air pressure for underfeed stokers.

X. Draft gages and the measurement of draft

HAVING OUTLINED the basic principles underlying the subject of draft in the preceding installment of this series we will now consider the measurement of draft, that is, how it is measured, what instruments are needed and where, throughout the gas passages the measurements should be made. Regardless, of the type of draft system employed, whether natural or mechanical, efficient combustion control is usually based upon some method of draft measurement. Even with hand firing, the fireman is usually provided with a draft gage for observing the overfire draft, even if there is no kind of automatic damper regulator installed.

If the fireman has a gage to tell the amount of draft in the furnace he can at least regulate the flue damper by hand and thus obtain fairly good combustion control.

The simplest type of gage for measuring draft is a U-tube about half full of water as shown in Fig. 1. A gage of this type, however, is not sensitive enough to accurately measure a small amount of draft pressure such as found in most furnaces where good combustion conditions are maintained. If the fireman is alert and trying to maintain good CO_2 readings he will usually hold the draft in the furnace at some point less than —0.10, provided, of course, he isn't operating with natural draft. But even if he were to hold the draft at —0.125 which would be equivalent to ⅛ in. when read on a U-tube, one can readily see that such a small difference in the heights of the water columns in the two legs of the U-tube would be difficult to read. For this reason manufacturers of draft gages have developed other types which magnify the movement of the liquid in the gage to such extent that it can be read to 1/200 in. or 0.005. The simplest of such gages is the inclined

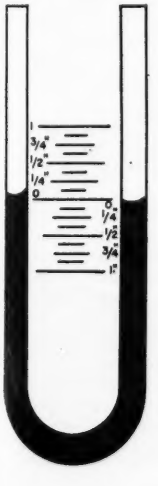


Fig. 1. The U-tube type of draft gage showing a negative draft pressre of ⅛ in of water

diaphragm (dry) type of gage which does not require any liquid but which, of course, has been calibrated to show movement in terms of inches of water. A pointer is mounted on the end of the last lever in the linkage of these types of gages and is read on a convex scale as the pointer moves up and down through an arc. Zero pressure usually is at the bottom of the scale.

Where and How to Measure Draft

Referring to Fig. 3 which is the same drawing which appeared as Fig. 1 in the preceding article, draft readings should be taken through the side of the uptake and walls of the furnace at points A to G inclusive. Under the conditions previously assumed for a chimney 200 ft. high at sea level and 550 F, if frictional losses are disregarded the draft reading taken in the uptake at A should be very close to —1.17 in. With the damper about three quarters closed the draft at B may be about —0.9 in., at C it may drop to —0.75 in., at D to —0.70 in., at E to —0.55 in., at F to —0.50 in. and at G to —0.35 in. The draft losses through the various passes of the boiler will, of course,

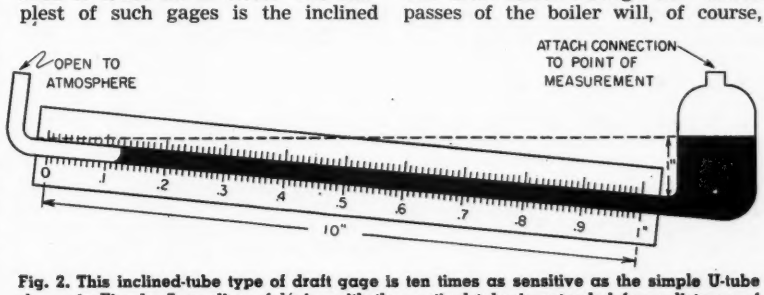


Fig. 2. This inclined-tube type of draft gage is ten times as sensitive as the simple U-tube shown in Fig. 1. A reading of ⅛ in. with the vertical tube is extended for a distance of 1¼ in. and is read as —0.125 in. of water

tube as shown in Fig. 2. In this type of gage, 1 in. of vertical height on the U-tube is extended through 10 in. on the inclined scale. This means that ⅛ in. vertical height on the U-tube is multiplied by 10. The effect, therefore, is the same as reading 1¼ in. on the U-tube instead of ⅛ in. This means that instead of the difficulty in reading ⅛ in. on the vertical scale of the U-tube, the liquid in the inclined tube as shown in Fig. 2 can be read with ease on the scale as —0.125 in. When reading the liquid in either a U-tube or an inclined tube, the level should be read at the bottom of the meniscus or curved portion of the liquid. Commercial designs of inclined gages usually have the reading scales calibrated to use a light oil instead of water. The oil is usually colored red for ease in reading. These gages must be mounted level and periodically checked by means of the spirit level with which they are provided.

Other types of draft gages which have been developed to magnify the movement of the liquid are arrangements in which the rise and fall of the liquid is translated to levers which amplify the movement such as the so-called inverted bell type or the vary with the load. In the conditions as assumed above, the differential pressure through the tube bank is the difference between —0.90 and —0.35 or —0.55 in. One manufacturer of combustion control equipment has synchronized the steam demand with such differential pressure. As the steam flow increases, more fuel must be burned, more air supplied and a greater volume of gases must pass through the tube bank. This means that the resistance through the tube bank will be greater and the damper must be opened wider in order to maintain the draft in the furnace at or near the original figure.

In taking draft readings at any point in the system the operator usually has to compromise between theoretical accuracy and practicality. One seldom finds uniform draft pressure at all points in a furnace or duct where gas or air is flowing. For this reason a series of readings should be taken at intervals through a cross section of the passage way, if average conditions are to be accurately determined. But as a practical matter, the fireman does not have time to take a series of readings at any given point and furthermore, if he were to at-

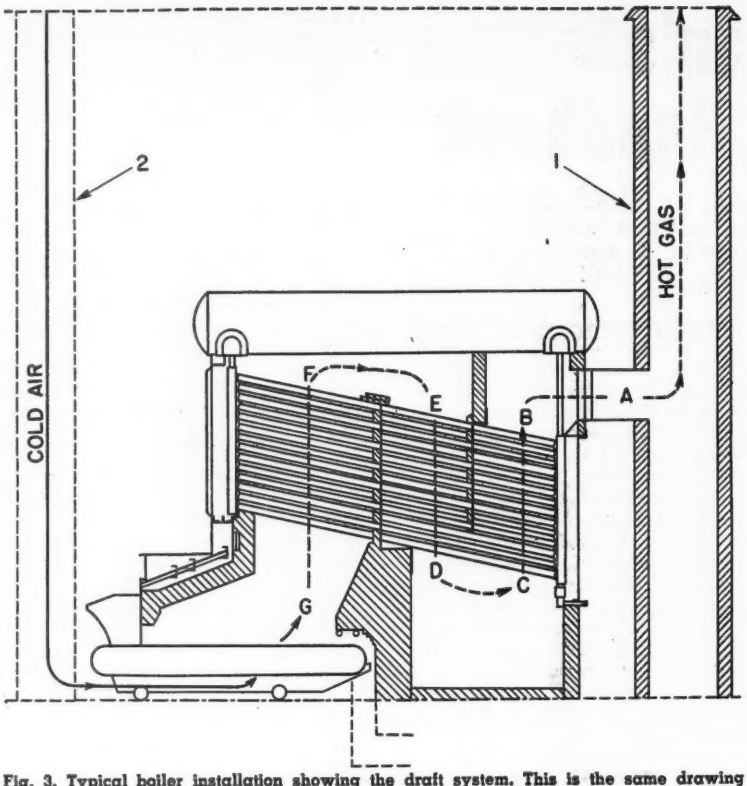


Fig. 3. Typical boiler installation showing the draft system. This is the same drawing that appeared as Fig. 1 in the preceding article

tempt to take readings across the furnace above the fire, using an ordinary iron pipe, the pipe probably would burn up.

Because of such limitations, pipes for measuring draft are generally inserted in the walls of the setting with the end flush with the inside of the wall or preferably an inch or two back of the inner surface of the wall. The opening in the brick work from the end of the pipe to the inner surface of the wall should be flared to prevent the opening from becoming sealed by fusion of the bricks. All piping for draft connections should be provided with tees and clean out plugs instead of elbows. Also it may be advisable to provide by pass connections to a source of compressed air so that the draft lines can be blown free of soot and dust. Care must be taken, however, to see that the draft gages are either closed off from the compressed air or disconnected when the lines are blown.

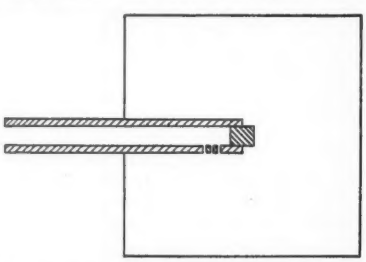


Fig. 4. This is a cross section of a square duct showing how a draft pipe, closed at the end and provided with three 1/16 in. diameter holes, should be inserted in order to measure static pressure The holes must be at right angles to the flow of air

In cases where it is desired to explore gas or air passages for variations in draft, the pipe which is inserted into the flowing stream should be closed at the end and provided with three holes on the under side about 1/16 in. in diameter, placed at right angles to the flowing stream near the end of the pipe as shown in Fig. 4. This shows a cross section of a duct in which the stream is flowing through the duct, either toward or away from the observer. Draft readings taken in the above manner are designated as static pressure readings if taken in the ducts of either forced or induced draft fans. Such pressure may be either negative or positive, that is the pressure may be either above or below atmospheric pressure. There is another type of pressure, known as velocity or impact pressure which is taken by having the opening in the pipe directly facing the flow of air or gas. Boiler firemen, in most cases are not concerned with such readings which are only taken when the operator is attempting to calculate the volume of air or gas flowing through a duct of known cross sectional area. Complete instructions for such procedure may be found in the fan test code sponsored by The National Association of Fan Manufacturers and some of the engineering societies.

A common cause of draft trouble is broken or leaky baffles. Another common cause of trouble may be found with chain grate stokers using natural draft. The air which should be drawn through the fuel bed may pass around the end of the stoker and up along the bridge wall into the furnace if the cinder seal at the rear end is not kept tight. Such a seal is shown in Fig. 3. If a considerable portion of the air needed for combustion is passing around the end of the stoker, the fireman will have to open the damper wider in order to cause some of the air to flow through the grates and up through the fuel bed. This will cause a higher draft in the furnace, lower CO_2 and higher flue gas temperature.

Firemen should always be aware of the fact that *air follows the lines of least resistance.* It will not flow through a fuel bed which offers considerable resistance to flow if it finds a larger opening at the end or sides of the stoker. Also it will flow through cracks in the setting rather than through the fuel bed. Cracks in the outside walls can be detected by the candle test, but cracks in baffles or in the bridge wall must be detected by exploration with a draft pipe and gage.

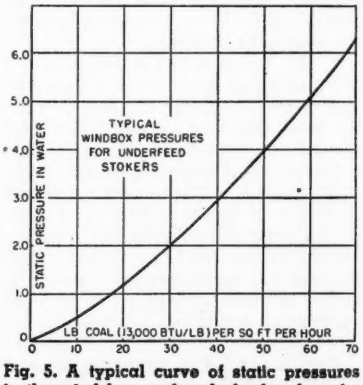


Fig. 5. A typical curve of static pressures in the wind boxes of underfeed stokers for varying combustion rates

At times, the flue damper may slip on its shaft and when the fireman moves the lever arm, thinking he is opening the damper, the latter will remain closed or partly closed. The fireman then is puzzled to explain his smoky fire and sometimes a positive pressure in the furnace.

The author once investigated a case of draft deficiency in an installation where a new forced draft traveling grate stoker had been installed. When the fireman started the operation, smoke poured out in front of the stoker and it was quite apparent that there was a complete lack of draft in the furnace. There was no induced draft fan since the draft through the furnace was provided by a very tall chimney. Since it was obvious that this chimney should have been adequate to produce the necessary draft an investigation was begun, starting at the base of the chim-

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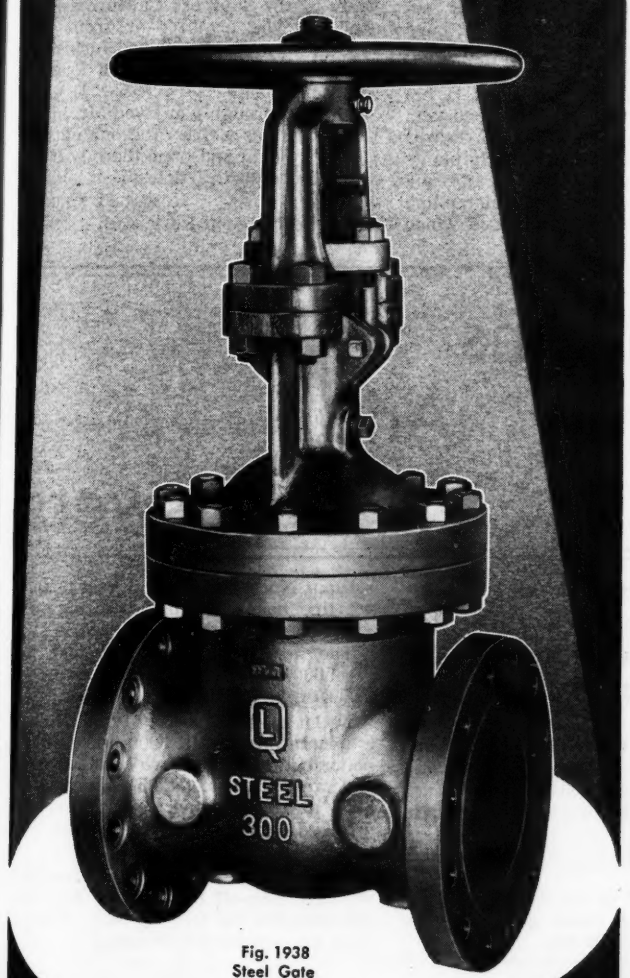

Fig. 1938
Steel Gate

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Lunkenheimer Valves—whether of steel, iron, or bronze—are *quality built to stay tight,* over years of service. They afford constant, dependable protection against leakage. Simplicity of design and a minimum of working parts assure extra long life and easy, economical maintenance.

We have prepared a chart, showing in dollars-and-cents figures, what leaky valves can waste in steam, water, and air. For a copy, write The Lunkenheimer Company, Cincinnati 14, Ohio, U. S. A.

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ney since the author once, in another case, had found an open inspection door at the base of a chimney. In the present case, however, the door was found closed but starting at the point where the breeching attached to the chimney, the author soon located the source of the trouble, incredible as it appeared. Construction steel workers had neglected to complete the job of fabricating the breeching. On top of the breeching, about 20 ft. from the chimney there was an opening about 8 ft. square where the steel workers had forgotten to rivet on a section of steel plate.

On another installation the author was called in to investigate draft trouble with a small single retort underfeed stoker with a turbine driven propeller type fan supplying the forced draft and a natural draft chimney for carrying away the products of combustion. The complaint was that the stoker wouldn't burn enough coal to carry the steam load even at about 90 per cent of rating. Draft readings in the furnace and upstake showed ample draft for at least 150 per cent rating, even with the flue gas temperature developed at 90 per cent rating.

The steam turbine driving the forced draft fan was provided with two overspeed nozzles but even when these were opened and the pressure in the windbox beneath the stoker boosted to 3.5 in., the fuel bed appeared as if the forced draft fan had been shut off. This indicated that the air was not being forced through the fuel bed. When a slice bar was used and some of the hot coals lifted up, the ash below appeared to be melted and it pulled out like taffy. This led to the conclusion that the molten ash had plugged up the holes in the grate bars.

After the fire was out and the furnace had cooled off sufficiently to examine the stoker, it was found that only about 10 per cent of the total air opening was delivering air for combustion. An analysis of the coal showed it to be of exceptionally poor grade. It had a heat value of 8800 Btu per lb. as fired and the fusion point of the ash was 1900 F. Low grade coal such as this should have been burned on a chain grate stoker where the ash would not have been disturbed and a low combustion rate could have been maintained. When a good grade of coal, of the quality specified in the stoker guarantees was supplied, there was no difficulty in meeting load conditions.

Air Pressures for Underfeed Stokers

Since firemen frequently want to know what air pressures are required for underfeed stokers, Fig. 5 may be used as typical for stokers of this type, although it should be understood that such pressures will vary with different designs of stoker and types of coal.

Deflector Control of Hydro-Turbines Used in 1898

REFERRING to C. R. Martin's article, "High Efficiencies Characterize Wartime Hydro Installation," appearing in Feb., 1945, issue of your magazine; and particularly to the top paragraph in the middle column on page 87 wherein reference is made to ". . . another method employed, first used . . . at Big Creek 2-A plant. This is to provide a means for quickly diverting the jet from the buckets. . . ."

I must take exception to Mr. Martin's statement that this method was first used as he cites. Even though the plant that I shall name might be considered an insignificant installation in these days; yet in those days it was relatively a much larger accomplishment than anything we have today, just because it was a beginning.

The plant that I have in mind is the old Hammond plant built, I believe, by John Hays Hammond and put into operation about 1898. It was one of three or four such early plants put into operation here in California about that time but was outstanding because of the high head used which was in the order of 1200 ft and which gave, as I recall, a static pressure of around 525 or 450 psi working pressure at full load.

As I recall, the wheels were about 4.5 ft in diameter and each had a needle valve. But the main control was a deflector somewhat like an upside down stirrup which was mounted so that the stream or jet went through the stirrup, but when it was rocked forward the jet was deflected downward, to the bottom of the housing.

Interesting too is the fact that the armatures rotated and the slip rings, or I should say, collector rings, were contacted by laminated copper brushes —at 440 v.

This plant, which later was superseded by a modern fully automatic plant, was operated for a number of years by the Southern California Edison Co. who acquired it from the original owners, after it had furnished power directly to the city of Visalia for many years.

I have thoroughly enjoyed Mr. Martin's article as well as the one on the Kentucky dam and hope there will be many more such articles.

HOMER H. CRIDER
Yosemite National Park, Cal.

Questions And Answers

Question No. 295

How Should Two Boiler Plants Be Operated to Serve These Loads?

WE HAVE a straight pipe line 4000 ft long and a boiler plant at each end of the line, as shown on the sketch. These conditions exist:

1500 ft of the line is 8 in. standard pipe.

2500 ft of the line is 12 in. standard pipe.

Plant No. 1 at the 8 in. end of the line has a steam generating capacity of 1000 bhp.

Plant No. 2 at the 12 in. end of the line has a steam generating capacity of 5000 bhp.

The industrial plant demand is 5000 bhp and the main line pressure is 125 psi.

Now let us assume that Plant No. 2 is generating its full 5000 hp. At the boiler end of the line we have 125 psi and we experience a 35 lb pressure drop at the far end. This pressure drop does not affect the process or heating load.

At five points on the main header we have take-off pipes which pull on the main line for 1000 hp each. These lines are spaced 800 ft apart.

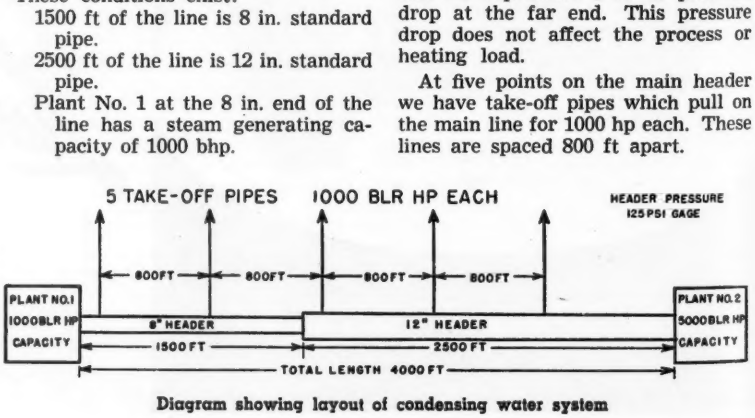

Diagram showing layout of condensing water system

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A job for seasoned executives—this 7th War Loan! Especially when we've got to make 2 war loans total just about as much as all 3 in 1944! Putting this over demands the combined and *continued* efforts of the "No. 1" men of American industry.

This means marshaling your plant drive to make every payday—from now 'til June 30th—do its share toward the success of the 7th. Directing the drive is not enough. It's equally important to check to see that your directions are being carried out—intelligently!

For example, has every employee had:

1. **an opportunity to see the new Treasury film, "Mr. and Mrs. America"?**
2. **a copy of "How To Get There," the new Finance Division booklet?**
3. **a new bond-holding envelope with explanation of its convenience?**
4. **7th War Loan posters prominently displayed in his or her department?**
5. **information on the department quota—and an urgent personal solicitation to do his or her share?**

Remember, meeting—and beating—your highest-yet 7th War Loan quota is a task calling for "No. 1" executive ability. Your full cooperation is needed to make a fine showing in the 7th! Do not hesitate to ask your local War Finance Chairman for any desired aid. It will be gladly and promptly given.

If you haven't a copy of this important booklet, "7th War Loan Company Quotas," get in touch immediately with your local War Finance Chairman.

The Treasury Department acknowledges with appreciation the publication of this message by

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With these conditions existing, let us fire up Plant No. 1 and supply 1000 hp to the main header. This question then arises:

How much load will be dropped at Plant No. 2? ? ? Or, to put it the other way, how much load will Plant No. 2 have to carry now?

Naturally the pressure throughout the entire length of header will be 125 psi. The 5000 hp demand will exist on the 5 take-off pipes.

How will the velocities be affected?

How will the condensation rate be affected?

Discounting operating labor and any difference in efficiency rate of equipment, would we be justified in operating both boiler plants and to what extent?

With the entire plant load off, the condensation rate during a shut down period was approximately 200 hp.

South Bend, Ind. P. E. R.

Question No. 296

Should These Turbine-Generators Be Installed or Should Power Be Bought?

THE PLANT where I am engineer in charge uses about 136,000 kw-hr of electric power per month. We have a demand charge of $740 per month. We pay about 0.016 cents per kw-hr, including demand charge. (His letter distinctly says 0.016 cents but we wonder if he doesn't mean $0.016 or 1.6 cents—Ed.)

The present day load, when all motors are on, varies between 425 kw and 450 kw. Night and day loads on Sundays and holidays average about 125 kw.

The management now wants to install two 750-kw turbine-generators. These would operate at 5 or 6 psi back pressure; the exhaust would be used for building heating from Oct. 1 to May 1; the other 4 months of the year we have no use for exhaust steam. Our building heating load is about 200 bhp. We do not have water facilities to operate the turbines condensing. In our present boiler room, the cost of coal only per 1000 lb of steam is $0.219 or 21.9 cents.

Would it be better for us to buy our electric power or put in the turbines and make it? I have no figures on the steam consumption of non-condensing turbines. But it seems to me that operating at 750-kw turbine at 450-kw or 125-kw would be uneconomical. What do Q & A readers think?

Indiana C. F. M.

More Details on Question No. 294

Why Is Barometric Condenser Water Backing Up?

When H. G. S., in the April issue, asked why water is backing up from his barometric condenser to a turbine, he said that the installation worked fine until about 5 months ago, but then the trouble started. He also wanted to know if too much water could be used with a barometric condenser.

We asked him for a diagram of his turbine and condenser connections. It arrived just too late for the April issue but we published the question anyway. Here is the diagram now; it may help in analyzing the trouble.

H. G. S. has also given us a little more information. He says the unit is 2 years old and the tail pipe is clean. "So much water is backing up," he says, "that it stops the turbine, and a turbine operating at 6250 rpm cannot stand much of that."

Is it possible that this water is coming from somewhere else and not backing up from the condenser? Could it be anything like the case described on pages 48 and 49, April issue? Is the refrigeration condenser heating the condensing water too much? Are the pumps operating properly? Suggestions from Q & A'ers will be appreciated for certainly "the turbine can't stand much of that."

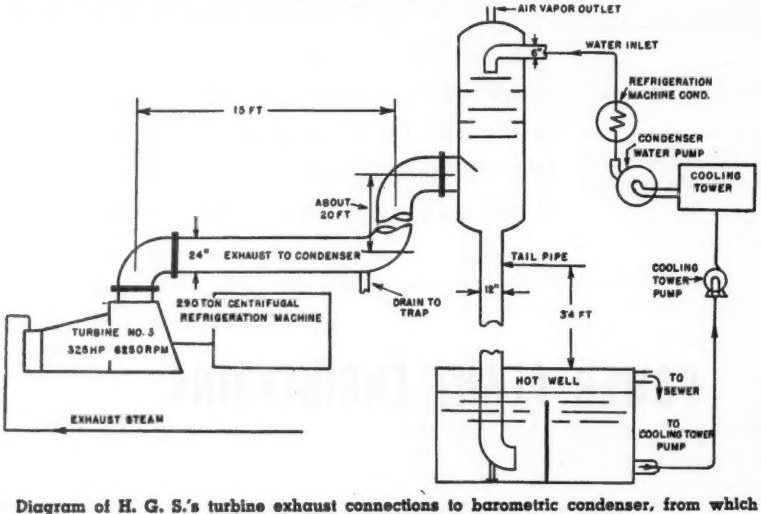

Diagram of H. G. S.'s turbine exhaust connections to barometric condenser, from which he says water is backing up into turbine

Answer No. 275

What Is P-T Relation at Freezing Point of Water?

IN THE November, 1944 issue, W. E. P. asked if water would remain liquid in a tight container as the temperature is lowered, so long as the container was strong enough to prevent the expansion in volume resulting if the water changed from liquid to solid.

Behind this apparently simple question was a very practical problem in the design of refrigeration fittings, which broke and leaked when water vapor froze in them. W. E. P. brought out these points in the January issue and showed how fittings were tested and redesigned. Roland J. Berti gave additional data on the volumetric changes and P-T relations in the February issue.

Calculation of Forces When Water Freezes

I HAVE FOLLOWED with interest the discussion of this question which started in your November, 1944, issue. J. E. Lancaster brought to attention in the January, 1945, issue the problem of to what extent the tendency of the ice to expand on freezing can be accommodated through elastic deformation of the container. This is a practical aspect of the problem which is worth exploring and on which I should like to contribute the following analysis for consideration.

To begin with, it is necessary to clear up any possible misconception which may exist concerning the magnitude of the volumetric expansion which takes place when water freezes into solid ice. Contrary to the explanation given by Roland J. Berti in the February, 1945, issue of POWER PLANT ENGINEERING, it is my understanding that water expands on freezing to something like 1.1 times its original volume, not to only the 1.00186 times assumed by Mr. Berti. The increased volume given in different handbooks ranges from 1.086 to 1.138 so that 1.1 is often taken as a reasonable value. Actually Mr. Berti's 1.00186 is not the correct expansion for liquid water either, since the 186 parts per million given in Fig. 1 on page 100 of POWER PLANT ENGINEERING for February, 1945, actually corresponds to a volume of 1.000186.

For simplicity, I have taken for purposes of illustration a hollow sphere having an inside diameter of one foot and containing water which was hermetically sealed in the sphere when at a temperature corresponding to its maximum density.

Example of the pressures and stresses exerted by the expansion of water in freezing inside a hollow sphere one foot in inside diameter

Case 1—Fully Elastic Sphere: If the sphere is made of *very thin* steel, expansion in freezing will be practi-

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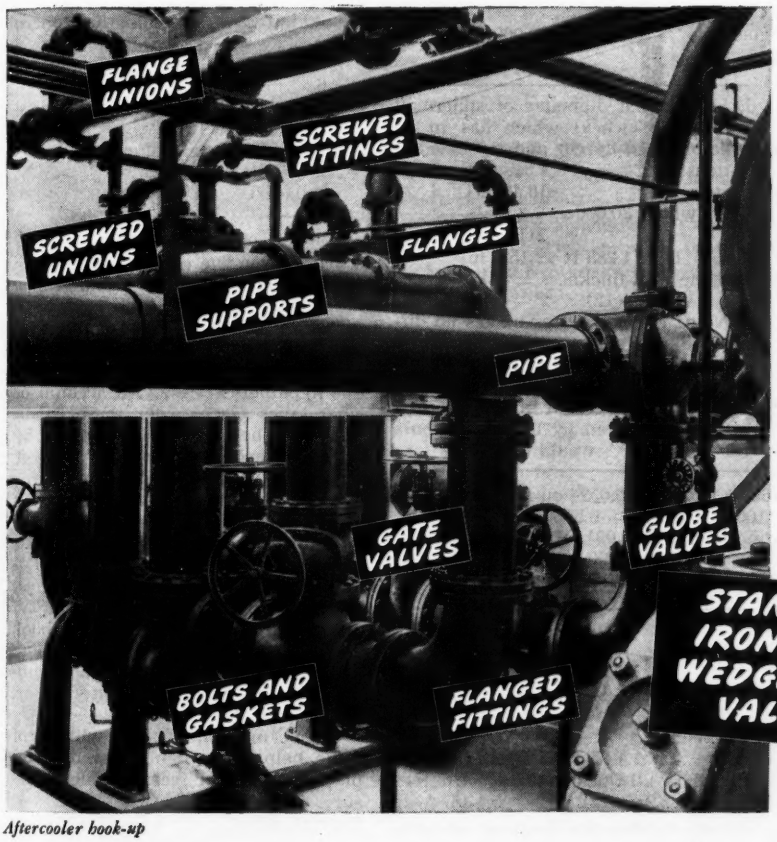
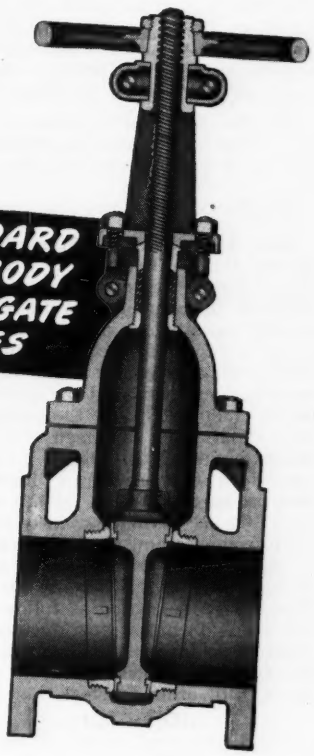


Aftercooler hook-up



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** with Brass trim are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S. & Y. and Non-Rising Stem patterns.

Working Pressures

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2-in., use Crane Clamp Gate Valves.)

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE **VALVES • FITTINGS • PIPE**
PLUMBING • HEATING • PUMPS

cally unresisted and the following conditions would obtain:

d = internal diameter of sphere, which is 1 ft (or 12 in) by assumption.

Volume of a sphere 1 ft in diameter = π d³/6 = 0.5236 cu ft
On freezing the volume would expand 10% to 0.5760 cu ft
On freezing the diameter would increase to 1.032 ft

The circumferential stretch in the thin metal skin is computed as follows:

Final circumference = 1.032 × 3.1416 = 3.2450 ft
Initial circumference = 1.0 × 3.1416 = 3.1416

Increase in circumference 0.1034

$$\text{Per cent elongation} = \frac{0.1034 \times 100}{3.1416} = 3.29\%$$

Computing the stress in the steel for 3.29% elongation
Stress = strain × modulus of elasticity = 0.0329 × 30,000,000
= 987,000 psi

This, of course, is an impossible answer since no steel could support this stress.

Case 2—Rigid Sphere: Water and ice are practically incompressible, having moduli of elasticity in compression of only about 1 and 2 per cent respectively that of steel. If the wall of the sphere could be made *thick enough* to prevent the ice from expanding hardly at all in freezing, this would be equivalent to compressing the ice back from a final volume of 0.5760 cu ft to its initial volume of 0.5236 cu ft. Using a coefficient of compressibility for ice of 0.000023 for each atmosphere, the pressure developed can be computed as follows:

The reduction in volume = 0.5760 — 0.5236 = 0.0524 cu ft
The % reduction in volume = (100 × 0.0524) ÷ 0.5760 = 9. 1%
The corresponding number of atmospheres = 0.091/0.000023
= 3960
The corresponding pressure = 3960 × 14.7 = 58,150 psi

Case 3—Minimum Strength of Sphere or Pipe Required to Prevent Water from Freezing: The pressure of 58,150 psi computed for Case 2 is several times higher than the liquefication pressure for ice at temperatures ordinarily encountered. In the contributions published in previous issues of POWER PLANT ENGINEERING, interest has been expressed in conditions obtaining at —10C (+ 14 F) for which temperature a liquefication pressure of 16,400 psi has been given. Hence it would seem of interest to compute how thick the wall of a sphere would need to be in order to support a pressure of 16,400 psi. This can be computed as follows by the Lamé formula* for thickwalled spheres, using a maximum stress of 30,000 psi corresponding to the yield strength of ordinary steel.

$$S = \frac{p(D^3 + 2d^3)}{2(D^3 - d^3)}$$

where S = stress in sphere wall due to internal pressure, which is 30,000 psi by assumption.

p = internal pressure, which is 16,400 psi by assumption.

D = external diameter of sphere in feet (or inches) which has to be determined by cut and try calculations.

$$\text{from which } 30{,}000 = \frac{16{,}400\ (D^3 + 2)}{2(D^3 - 1)}$$

D = 1.285 ft = 15.4 in.
and the wall thickness =
(15.4 — 12) ÷ 2 = 1.7 in.

Note: Feet or inches makes no difference here since the 12s cancel out.

In considering a cylindrical pipe instead of a hollow sphere, the maximum hoop stress at the inner surface as computed by Lamé's formula for cylinders** would be:

$$S = \frac{p(D^2 + d^2)}{D^2 - d^2}$$

$$30{,}000 = \frac{16{,}400\ (D^2 + 1^2)}{D^2 - 1^2}$$

D = 1.85 ft = 22.2 in.
and the wall thickness =
(22.2 — 12) ÷ 2 = 5.1 in.

Which verifies the frequent observation that water in freezing to solid ice exerts a force which ordinarily pipe materials and wall thickness cannot support without bursting or permanent distortion.

The minor effect of contraction of the sphere with change in temperature has been neglected as of secondary importance in this demonstration since the wall will stretch five times as much circumferentially under a pressure of 16,400 psi as it will contract from the reduction in temperature.

Case 4 — Behavior when Cooled from + 4C to — 10C: According to Fig. 1 on page 100 of POWER PLANT ENGINEERING, February, 1945, water, if kept under sufficient pressure to *prevent* freezing, will increase in volume by 186 parts per million when cooled from + 4C to — 10C (i.e. from 39 F to 14 F). This relatively small increase in volume will be accommodated by the elastic stretch of the sphere produced at the internal pressure of 16,400 psi as shown below:

Circumferential strain = stress ÷ modulus of elasticity = 30,000 ÷ 30,000,000 = 0.001 units per unit.
Diametrical strain = 0.001 ÷ 3.1416 = 0.000318 units per unit.

For a sphere having an initial inside diameter of 1 ft, the increase in volume is computed as follows:

The final volume of the sphere = $\frac{\pi}{6} - 1.000318^3 = 0.5241$ cu ft

The initial volume of the sphere $\frac{\pi}{6} - 1^3 = 0.5236$

The increase in volume of the sphere = 0.0005 cu ft

The increase in volume in parts per million =

$$\frac{0.0005 \times 1{,}000{,}000}{0.5236} = 957$$

which is over five times the 186 parts per million which the liquid water expanded.

From which it seems probable that water in the sphere will be in a partly liquid and partly frozen condition in this hypothetical case. An account of what takes place under these conditions will be found in an article by C. E. Larard and F. A. W. Oliver published in the English magazine "Engineering" some years ago.†

Those wishing to examine the more profound technical aspects of this problem can refer to Properties of Ordinary Water Substance, by N. Ernest Dorsey (Physicist, National Bureau of Standards), published by the book department of Reinhold Publishing Co. This book deals with "water substance in all its phases, water-vapor, water, and all the ices."

I hope my contribution will be of some help in explaining what takes place when water freezes under pressure.

Detroit, Mich. SABIN CROCKER
The Detroit Edison Co.

*See Theory of Elasticity, by S. Timoshenko, 1934 (McGraw-Hill Book Co., Inc.), page 326.

**See Piping Handbook by Walker and Crocker (McGraw-Hill Book Co., Inc.), 3rd ed., page 43.

†The Effects of Frost on Water-Charged Lead and Copper Pipes, Engineering, June 10, 1932, pages 673-676.

Answer No. 283

Why Is Water Level Hard to Control?

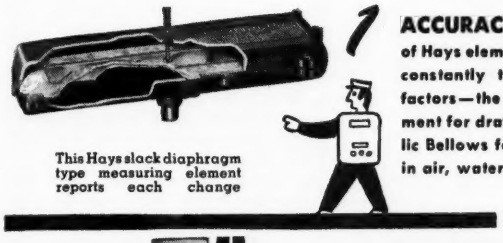
G. B. HAS GOTTEN US and a large number of Q & A readers thoroughly embroiled again in the entire subject of boiler circulation and how boilers make steam. He has done this by asking in the December issue, with all the wide-eyed innocence of little Rollo himself, "Why is the water level in our new four-drum vertical bent-tube boiler harder to control than the level in our two old straight-tube cross-drum units, all having the same type of feedwater regulators and operating in parallel?"

Here's the sort of thing that question leads to:

ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!

HOW HAYS COMBUSTION CONTROL

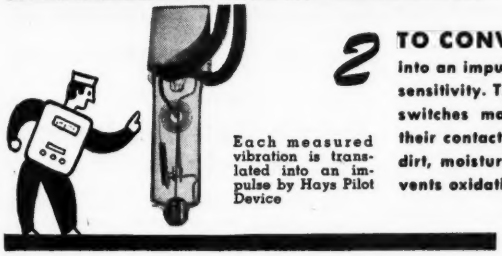
gives you 1 accuracy • 2 sensitivity • 3 speed • 4 power



This Hays slack diaphragm type measuring element reports each change

1 ACCURACY A CONSPICUOUS FEATURE

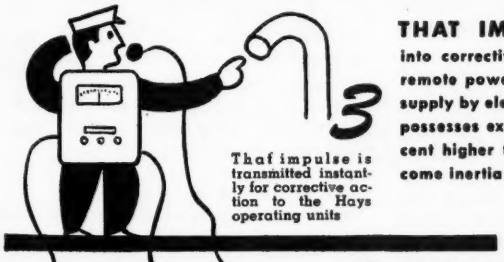
of Hays elements for measuring the minute changes constantly taking place in variable combustion factors—the Hays diaphragm type measuring element for draft and low pressures; and Hays Metallic Bellows for measuring steam or high pressures in air, water or oil.



Each measured vibration is translated into an impulse by Hays Pilot Device

2 TO CONVERT EACH MEASUREMENT

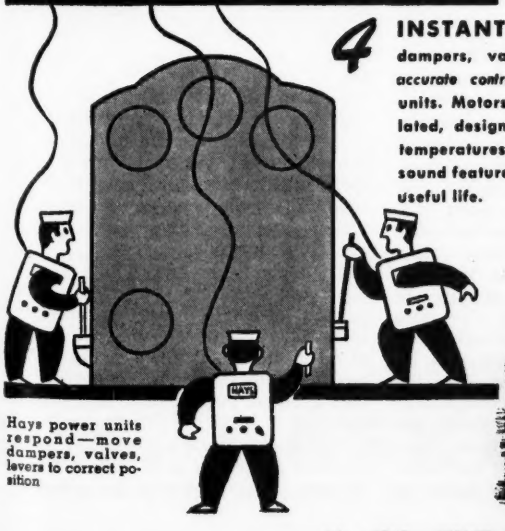
into an impulse calls for a pilot device of extreme sensitivity. The Hays pilot consists of two mercury switches magnetically operated. Fully enclosed, their contacts are effectively protected from dust, dirt, moisture; and blanketing with nitrogen prevents oxidation—a guarantee of long life.



That impulse is transmitted instantly for corrective action to the Hays operating units

3 THAT IMPULSE IS TRANSLATED

into corrective action, delivered instantly to the remote power units operating fuel feeder and air supply by electrical transmission. The Hays system possesses excessive starting torque—25 to 75 per cent higher than moving power—ample to overcome inertia and create quick action.



Hays power units respond—move dampers, valves, levers to correct position

4 INSTANT ACTION FOR MOVING

dampers, valves or levers *to the right point for accurate control* is the function of Hays power units. Motors are fully enclosed, effectively insulated, designed for installation in high ambient temperatures. Manual operation is available. Many sound features assure easy maintenance and long, useful life.

You SEE the 12 Vital Facts of MODERN COMBUSTION CONTROL in HAYS SALES VISUALS

The most comprehensive, most understandable explanation of automatic combustion control ever compiled. Ask the Hays representative to show it to you.

1. The purpose of Combustion Control.
2. How that Purpose is accomplished—3 methods of control.
3. What results can be expected of each.
4. Elements of a *good* control system.
5. Elements of a good controller.
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
8. How Automatic Combustion Control operates.
9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

This is the simple, dependable, automatic system that is saving big sums for industry of every kind—saving many man-hours, saving fuel, doing a *better job*, more dependably: Hays Electrical Combustion Control. A sensible way to see how it will help your business is by means of the Hays Visual Presentation. A line to us will arrange it.

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COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

How About Circulation in 2-Drum and 4-Drum Boilers?

The discussion of Question No. 283 by Walter Heidecker in the March, 1945, issue, the fine article How Steam Is Released in Modern Boiler Drums by Max H. Kuhner in the September, 1944, issue, and the comments in the April, 1945, issue, have been particularly interesting to me. Our company is contemplating the installation of modern boilers and no decision has yet been reached between the 2-drum and the 4-drum type of bent-tube boilers.

I shall appreciate any information you can send me concerning comparative circulation in these two types of boilers, also on water concentration for good operation.

Missouri H. G. S.

Here are just a few of the items we have suggested that will give some help in studying this whole subject of water circulation and steam generation in boilers:

Steam Power Stations, by G. A. Gaffert, McGraw-Hill Book Co., N. Y., pages 184 and 185; discussion of circulation in 2-drum and 4-drum boilers, with method of calculating circulation.

Boiler Capacity Has Outgrown Its Terminology, by Otto de Lorenzi; Combustion, March, 1934.

Practical Methods in Boiler Water Conditioning; W. J. Wright, Power Plant Engineering, February, 1945, pages 110, 112.

Suggested Rules for the Care of Power Boilers, American Society of Mechanical Engineers, 29 West 39th St., N. Y.

What the Power Engineer Needs to Know About Continuous Blowdown on Boilers, by Robert T. Sheen; Power Plant Engineering, January, 1945.

New 100,000-lb-per-hr Boiler Saves $100 a Day in Fuel, by C. H. Morrow; Power Plant Engineering, June, 1944; contains discussion of details of 4-drum boiler to improve circulation, water level control charts, etc.

Answer No. 289

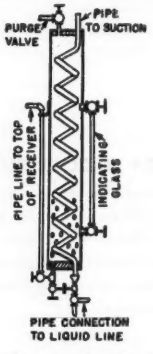
The Mystery of the Missing NH_3

Tips on Where to Look, from Bachmann

WELL, WELL, our friend W.E.D. is mystified as to the disappearance of NH_3. Naturally, any engineer would have done the same checking of all exposed piping and valves for any possible leak. However, he did not state whether his plant is of the indirect expansion or brine circulating system with a possibility of a hidden leak in the brine evaporators. This is not so easily detected without evaporation of brine in conjunction with litmus paper, etc. The result or success with such methods depends to a large extent upon patience and thoroughness.

If such a method of locating an ammonia leak is too tedious, he may call upon the assistance of a chemical engineer familiar with such analysis. However, if the cylinder jacket (not knowing type of machine) or the condenser water should absorb the disappearing ammonia, the same method could be applied to either type of condenser.

Also, I should like to suggest inspection of the safety valves; perhaps one or more of the several installed safety valves, piped to the atmosphere above the plant roof, could be leaking.



Sketch by Bachmann showing construction of separator for automatic purging of a NH_3 system

To ascertain this he should remove the inspection plug on the side of the safety valve. (CAUTION: do not remove safety plug of relief valves connected from the high pressure into the suction line without pumping down). If ammonia is not leaking through the relief valve, then, before screwing the inspection plug back, pour a good grade of oil into the inspection hole. This oil will help retard internal atmospheric corrosion in the relief or safety valve.

Now last but not least, perhaps W.E.D. is purging the system manually. If so, there is a possibility that all the diminishing ammonia is wasted, because satisfactory and effective purging of foul air or non-condensable gas can seldom be accomplished with manual purging and the plant in operation. In conclusion, therefore, we shall try and enlighten him with the operating principle of an automatic purger as shown in the sketch.

The cylindrical portion of the separator is open to condensing pressure connected to the top of the ammonia receiver. Liquid ammonia is expanded through the spiral expansion coil, which subcools the liquid in the separator below the boiling point corresponding to the condensing pressure. A combination of non-condensable gas and ammonia will pass, into and up through the cold body of liquid in the separator, condensing the pure ammonia gas that would otherwise be wasted or lost. This condensed or liquefied ammonia is returned to the receiver and the non-condensable gases thus separated rise above the surface of the liquid and are continuously discharged while the plant is in operation until every ounce of this foul air is expelled and removed from the system.

Huntington, W. Va. CARL BACHMANN

Check Condenser Water at Discharge

I WOULD SAY check the waste water leaving the condenser. Water, as you know, dissolves great quantities of ammonia, and if the waste water may go directly into a sewer, this type of leak is very apt to be overlooked. This is especially true of the enclosed types of condensers, i. e., shell and tube, tube in tube, multipass, submerged, etc.

Bronx, N. Y. PETER PILKO

Look at Evaporator Coils, Condensing Water

W. E. D. GIVES very little information as to just what his equipment is. I suggest he first test his brine for leaks in evaporator coils, and second his condenser exit water. Then, if unable to find leaks, pump out the system, use the compressor for putting air pressure on the system and test with soap water.

The brine and water from the condenser would be very easy to test by heating a small amount and holding a sulphur stick (lighted, of course) over it.

Louisville, Ky. HOWARD F. PARKER

Answer No. 290

Lubrication and Inspection Schedules

IN THE MARCH ISSUE, W. E. and others asked for practical suggestions on making up schedules for lubrication and maintenance of motors and other equipment. Here are a few of the early replies that have come in.

Parks Advocates a Card File

ELECTRIC MOTORS fall into two general classes: (a) motors using oil and (b) motors using grease. The first class may be divided into two divisions: (a1) ring-oiled motors and (a2) wick-oiled motors.

Motors using oil of either type require more frequent inspection than ball bearing or greased motors. This is due to a number of possibilities of failure. Some of these are: Knocking off an oil cup or gage glass causing oil to run out; drain plug working loose or leaking; glass breaking or leaking; leakage due to capillary contraction at the ends or at the splits in case of a split end bell. This type of bearing has to be checked for ring stoppage either due to breakage or sludgy oil.

The second class (a2) which is wick oiled or sometimes referred to as packed bearings must be checked oftener because of the smaller amount of oil in storage in the bearing. Ball bearing motors, when properly cleaned and greased require far less attention.

The most efficient method of checking that I know of is to have a small file box. Each motor in the plant is

HE'S IN GASKETOPIA!

That's the particular heaven of a man with perfect confidence that his boiler and flange gaskets are tight and leakproof—secure for long service even under the toughest operating conditions. His assurance is confirmed by the experience of marine and stationary-power men from coast to coast who specify AJAX Spiral Wound Gaskets for steam pressure applications up to 2500 psi.

AJAX Gaskets are designed and constructed by men who have specialized in gasket-engineering for over a quarter century. Here are simple construction facts:

A single strip of metal is preformed into a U-shaped groove and wound spirally from the inside to the outside. Two parallel thicknesses of UGASCO Asbestos filler are inserted between each metal ply. A functionally important air space between each of these thicknesses of asbestos makes AJAX "the gasket that breathes". Gaskets for varying pressure conditions are wound within a set OD and ID. This metal-asbestos spiral wound construction has extended the effective service life of AJAX beyond that of an ordinary gasket.

AJAX Spiral Wound Gaskets are worth specifying. When you see "United States" or "Ajax" on your gaskets it's like seeing "Sterling" on your silver. Write for Catalog 202 today.

Distributors in Principal Cities ★ ★ *A few choice industrial territories are open*

U. S. GASKET CO.

1596 PIERCE AVENUE, CAMDEN, NEW JERSEY

★ **"THE STORY BEHIND THE GASKET THAT BREATHES"**

Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions — and retains the positive, secure seal you require at all times.

The above cutaway is the AJAX SR Compression Gauge Flange Gasket

given a separate number known as the plant number. All references to the motor are made by the plant number. A file card, known as the main file card is made out bearing the following information: Type of machine using the motor; make of motor; type, phase, voltage; hp; rpm; type of bearing and lubrication; interval of inspections.

A separate card is made out bearing the plant motor number, date of inspections and work done. When this card is full, a new card is entered. A poster is erected in a conspicuous place to read like this: Check ring-oiled bearings Mondays; check wick-bearings Tuesdays and Fridays; check ball bearings first day of each month.

When glancing at the poster, we find that certain motors come due for inspection, take the date cards out of the file of all of this type motor and hand them to the man in charge of these motors.

The man takes the cards and inspects the motors. When the work is done, the man lists on the card all the work done, amount of oil or grease used and the date and his name or initials. These cards are then returned to the file for the next inspection.

This method is also very useful for ordering parts, checking horsepower used or for any other information required. The cards should give one a thorough knowledge of the motors. Any information that may be of value should be listed on them.

Baltimore, Md. CHAS. W. PARKS

He Uses Loose-Leaf Log Books

THE SYSTEM used in maintaining a schedule of inspections, oiling, cleaning, etc., in a group of power plants in which I was formerly employed as second operator may assist the man asking the above question.

A new employee was required to stand two watches on each of the three 8-hr shifts, where he was required to do the regular work of each watch under the instruction of the regular man on this watch, who was held responsible for seeing that he was properly instructed.

Near the log desk was a folder of blue prints showing the location of each unit of equipment and the route to be followed on each round of inspection.

In the log desk there was a loose-leaf binder labeled "Operating Orders and Instructions." On reporting for work at the beginning of each watch, both first and second operators were required to read their operating orders. The orders were in two sections.

The first section detailed the duties to be performed on each watch: which duties by the first and which by the second operator.

The seconnd section, subdivided into days of the week, detailed the duties to be performed by each watch on that particular day.

Duties to be performed at longer intervals than weekly, or at irregular intervals, were also detailed. In these cases, however, each day the chief operator made up a list, which was clipped to the regular list for that day, to insure that they would not be overlooked.

Following these sheets, the book contained further instructions describing each piece of equipment, with detailed instructions as to how it was to be serviced.

On completing a round of the plant, the second operator reported to the first "Station Normal," or any irregularities he may have noted. This was entered in the log book. All routine duties were regularly logged.

Besides the log book, a supplementary loose-leaf log book, called the "Overhauling Log Book," was maintained. This book contained a sheet for each unit of equipment. In it were entered all repairs, replacement of parts, special servicings, etc., with comments or observations that would be of assistance in securing better performance.

HOWARD T. LIVINGSTON

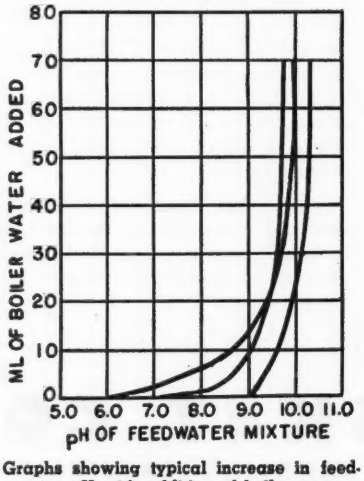
Los Angeles, Calif.

Answer No. 291

What Do You Do About Boiler Feed Pump Corrosion?

Editor's Note—In asking this question in the March issue, R. H. H. stated that to help ease the condition, they are recirculating a small quantity of boiler water.

Readers desiring details of recirculation for this purpose should refer back to a discussion of Recirculation of Boiler Water to Prevent Corrosion, by R. B. Conlan of the Chemical Engineering Staff of W. H. & L. D. Betz, appearing in the February, 1944, issue of P. E. & E. That article discusses: uses or purposes of recirculation, with particular emphasis on preventing feed pump corrosion; chemistry involved; quantity recirculated, mechanical equipment required and limitations. The article was republished from The Betz Indicator, November, 1943, where it was illustrated by the accompanying chart.



Graphs showing typical increase in feedwater pH with addition of boiler water

They Feed Sodium Sulfite at Pump Suction

ALTHOUGH I am not an authority on erosion or corrosion of boiler feed pumps at high pressures, I would like to pass on to R. H. H. some of our troubles and what we did to lick them. Of course, our water pressure was only 350 psi.

Not being familiar with the type of plant and the type of feedwater treatment but assuming, of course, that the feedwater is pumped away from a deaerating feedwater heater, I'll try and explain how we overcame our trouble here at the plant.

We also recirculated part of our boiler water through the pump but we found that the suspended matter or sludge was slightly abrasive and also it built up our boiler concentrations too high. As we exhaust into a closed system, with the exception of water losses through our prime mover traps, we get most of our returns back to the boiler.

We have about a 2 per cent continuous blowdown loss, which is necessary to skim off the suspended matter or sludge from our boiler drums.

On account of the abrasiveness of the sludge in the boiler water, we discontinued recirculating the boiler water through the pump. We also cleaned and inspected our feedwater heater. We found quite a large amount of scale on the trays, some of which was loose and probably was falling into the feed pump suction line.

That seemed to take care of the erosion. We then installed a 50-gal drum with a proportioning pump, the discharge of this pump being connected to the suction of the boiler feed pump. We dissolved about 5 lb of sodium sulfite in the 50-gal drum and regulated the proportioning pump to pump the 50-gal solution over a 24-hr period. Of course, we don't use 5 lb of sodium sulfite every day; since we maintain a concentration of about 90 ppm of sodium sulfite in our boiler water, the amount we use daily will vary. Sometimes we only use as little as 3 lb per 50-gal drum. The other boiler feedwater chemicals are pumped into the boiler directly every two hours with a special pump provided for that particular service.

Recently we took the casing off our multistage boiler feed pump and found the inside of the casing and the impellar blades in very good condition. There did not appear to be any signs of erosion or corrosion in the pump. We have used this pump 24 hr per day for 3½ years.

JOHN F. SLAVINSKY

Rochelle Park, N. J.

1908

Introduction of thermal expansion type regulator invented by James W. Copes. The first real step toward effective feed water control.

1913

Copes Engineers announce new and revolutionary method of feed water control—"continuous feed varying with load, and level varying inversely with load."

1916

Initial research on flow through control valves, leading to design for individual boiler conditions.
First 6-inch regulator ever made installed at Delray Station, Detroit Edison Company.

1917

Research into the influence of excess pressure variations on feed regulation, resulting in development of first differential pressure devices.

1918

Development of rotary stem control valves to reduce stem friction to low and constant amount, as against high variable friction of sliding stem.

1919

Manufacture of Copes Regulators begun in foreign countries. Within a few years Copes became the accepted standard in Europe, Asia, South Africa.

1920

Copes Regulators installed on 1100 psi. European-built boilers when 450 psi. was highest pressure in the United States.

1921

Originated tight seating valve fittings having equal upper and lower seat areas. Patent granted.

COPES

Leaders and Specialists for 36 Years in

BOILER FEED WATER CONTROL

NORTHERN EQUIPMENT CO. *1241 Grove Drive, Erie, Pa.*

Feed Water Regulators • Pump Governors • Differential Valves • Liquid Level Controls • Reducing Valves & Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND — REPRESENTATIVES EVERYWHERE

1924

Copes Regulators designed with expansion tubes in TENSION set new record in simplicity and reliability. Patent granted.

1926

First successful multiple element feed water control—Copes—installed at Ford Motor Company.

1927

Copes installed on first 1400 psi. boilers in the United States—Boston Edison Company.

1928

Basic patents secured on combination of feed water regulator and differential pressure valve.

1930

First 8-inch feed water regulator—a Copes—installed at New York Steam Company.

1932

After careful tests and investigations, all radio controlled ships of U. S. Navy equipped with Copes Regulators.

1934

Six years' research completed with development of first valves really balanced under operating conditions.
Patents granted on 2 types of 3-element regulators.

1937

Patents granted on remote control of feed water regulator and other control valves.

1938

Produced the Copes Flowmatic, a 2-element regulator—recognized as one of the greatest advancements in the art of feed water control for modern boilers.

1941

Introduced a Copes Marine Regulator not influenced by roll or pitch of the vessel. Now installed on hundreds of ships.

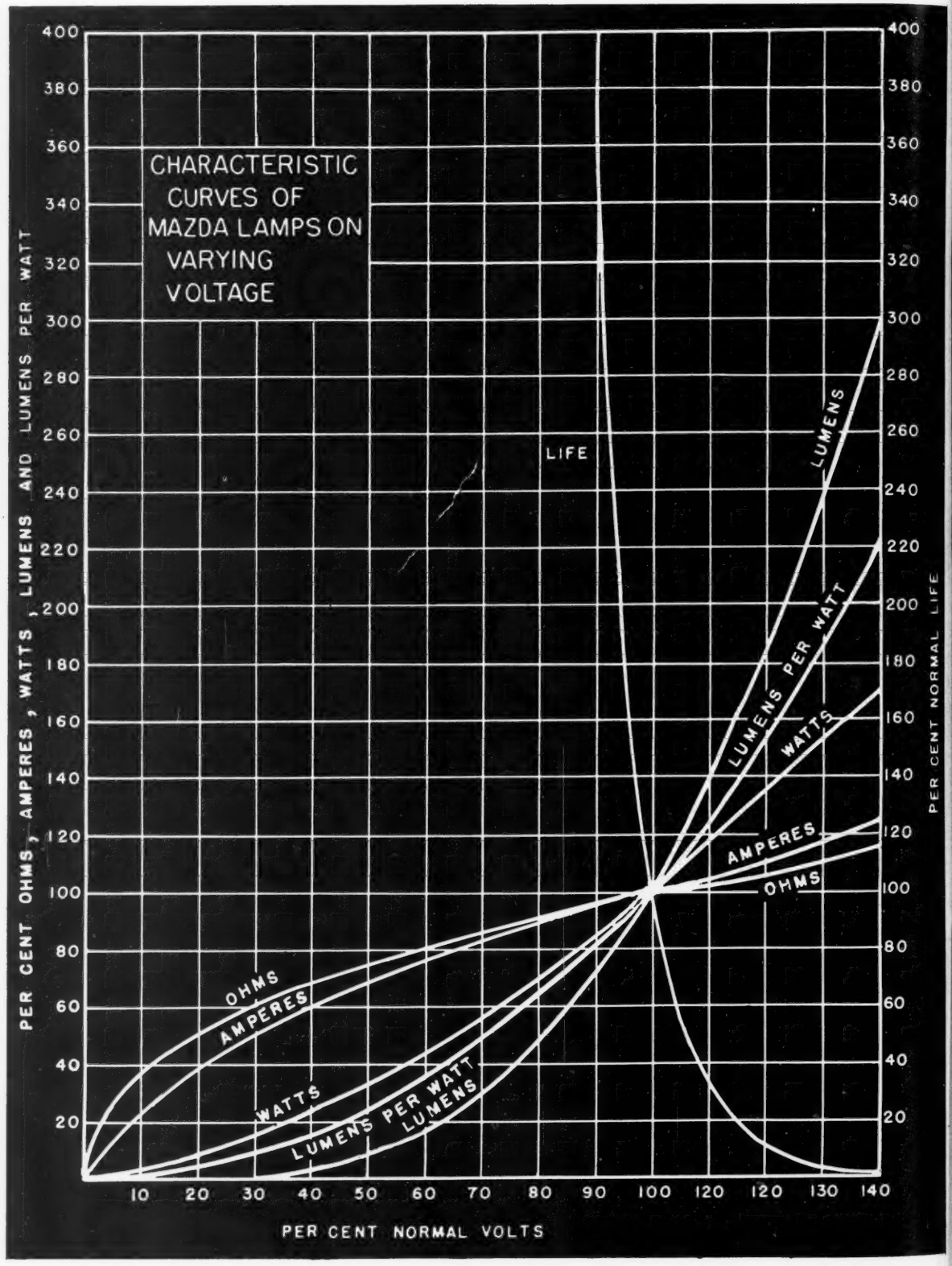
1942

Copes Flowmatics installed on largest forced circulation boiler in the world—650,000 lbs. per hour at 1825 psi.—Montaup Electric Company.

194X

Peacetime application of developments and improvements fostered by intensive war production activities.

Curves Showing Characteristics of Mazda Lamps



SUN DIESEL LUBRICANT . . .

Keeps Overloaded Diesel in Top Shape, Ends Stuck Rings, Cuts Carbon by 60%

When a Diesel engine is overloaded continuously, it provides the toughest kind of testing-ground for lubricants. War-time requirements kept a manufacturer's Diesel operating at constant overload.

Top rings stuck, usually within two or three months, and exhaust-ports were constantly getting clogged with carbon. Three lubricating oils, furnished by different, well-known suppliers, all gave the same results, had to be changed four times a year.

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Cold Water Deaeration

Corrosion arrested by removal of oxygen and carbon dioxide from cold water . . . Principal factors governing corrosion . . . Growing need for better process water . . . Deaerators working on vacuum principle are applicable to water as low as 40 F in tempertaure

By C. E. JOOS, Sales Manager, Apparatus Div., Cochrane Corp., Philadelphia, Pa.

THE UTILIZATION of large quantities of raw water in process cooling systems such as through condensers and heat exchangers has brought about a demand for cold water deaeration to arrest corrosion of these equipments without wastage of heat. In many process industries the heat pickup through such equipment by the cooling water is taken to the power plant, where this water is a source of makeup. The ordinary water supplies, however, indicates corrosion does occur and in order to protect these units, cold water deaeration has become quite prominent the past several years.

In order to understand the mechanism by which cold water deaerators protect piping and equipment from corrosion, it is well to outline the factors that govern water corrosion.

Factors Governing Corrosion

In general the corrosion of steel piping is governed by three principal factors—

(1) Amount of oxygen in solution.

(2) Amount of carbon dioxide in solution.

(3) Temperature of the water.

(1) The oxygen content governs the extent to which corrosion takes place,

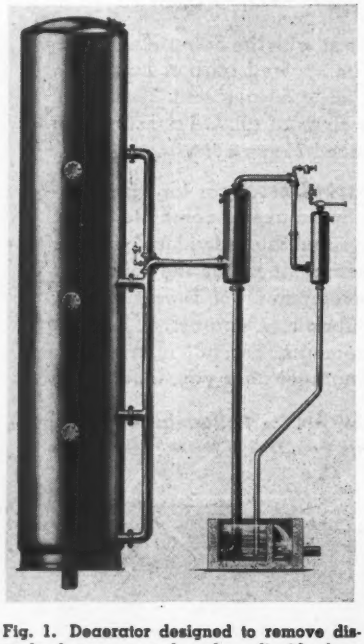


Fig. 1. Deaerator designed to remove dissolved oxygen and carbon dioxide from water below 40 F

as it is this element which combines directly with the iron in order to form products of corrosion—iron rust, such as ferrous oxide, FeO; magnetic oxide, Fe_3O_4; or ferric oxide, Fe_2O_3, the type of product depending upon the concentration of oxygen present at the time rusting takes place.

(2) Carbon dioxide in conjunction with the natural alkalinity of the water governs the pH value, which is a means of expressing the active acidity or alkalinity of the water, and this pH value influences the rate at which corrosion proceeds; the lower the pH value the more acid the water, and the greater the intensity of the corrosion; conversely, with higher pH values the corrosion activity becomes less and in some cases where the temperature is not increased appreciably corrosion can be arrested by merely the addition of alkali and raising the pH value; this is a common practice in municipalities and has been successful in arresting corrosion of distribution systems.

This method of itself, however, has certain limitations, as it is not always practical to add sufficient alkali to raise the pH value to the degree where corrosion would be arrested, as this might interfere with process requirements, particularly so if the water after being heated is used directly in the process, also for very large quantities of water an addition of this alkali would involve considerable chemical cost. If the water is high in hardness the addition of alkali would likely cause precipitation of the hardness, resulting in accumulation of deposits in pipe-lines, loss of capacity and ultimate stoppage.

(3) The temperature of the water is governed by the process requirements and is fixed by the design of heat exchangers and the rate of heat transfer, and it, therefore, becomes impractical to attempt to govern the rate of corrosion by control of the temperature, although it is well known that corrosion of steel increases very rapidly with increase in water temperature, when the water contains quantities of oxygen and carbon dioxide in solution.

Corrosion in commercial installations effected by mineral acidity, such as sulphuric acid and hydrochloric acid, occurs only rarely, since water supplies containing these acids are usually contaminated by industrial waste, and precautions are generally taken to neutralize this by the use of alkali, such as lime or soda ash. Certain types of processes, however, have to do with acid waters continuously, such as mine waters, and in order to combat corrosion in these cases, two procedures are generally followed:

(1) Use of acid-proof materials, or

(2) the addition of lime to neutralize free acidity.

Need of Cold Water Deaerators

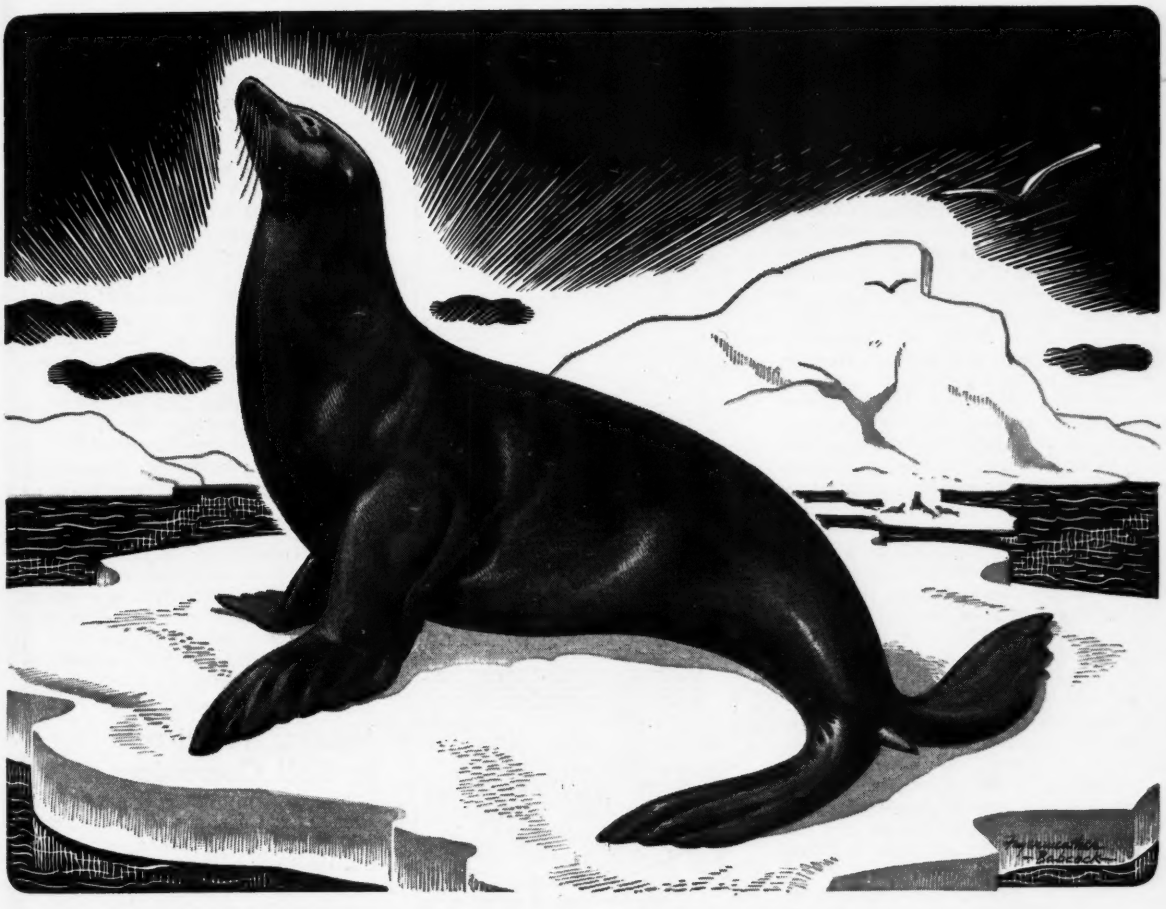
In order to remove oxygen and carbon dioxide from solution and have a non-corrosive water, it is desirable to do this without chemicals and with a minimum amount of mechanical equipment. It is also desirable to have this equipment such that it requires the least operating attention, maintenance and cost.

To give the greatest amount of protection to steel piping and steel equipment such as heat exchangers, etc., it is obvious the most reliable means of arresting corrosion is by the elimination or sharp reduction of the oxygen and carbon dioxide. Since in the mechanical removal of these gases the only cost involved is the initial equipment and the operating cost is only that of the vacuum-producing equipment, it therefore becomes the simplest and cheapest means where large quantities of water are to be handled.

The cold water deaerators as discussed here take into account the deaeration of water without the addition of heat or increase of the temperature of the water under treatment. Deaerators of this character are becoming increasingly necessary because of the requirements for better and purer process water. Such pure water saturated with oxygen and with only a few parts per million carbon dioxide, would be intensely corrosive to steel equipment with any appreciable increase in temperature. In addition new chemical processes to be successful may require not only extreme purity of water, but the elimination of gases. This combination of circumstances has led to the rapid development of the cold water deaerator within the past few years.

The Art Is Not New

The art of deaerating water cold is not new, one of the first installations that went into service on a large scale was in 1917. This installation, representing a pioneer endeavor, was capable of deaerating six million gallons of water per day, consisting of two units, each capable of treating three million gallons of water



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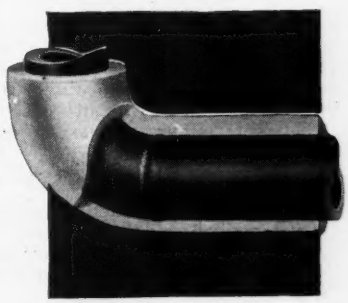

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in 24 hr. This rather elaborate installation deaerated the water by spraying it in a vacuum chamber. It was successful in checking corrosion of 30-in. steel pipe in a line 350 miles long from Mundaring to Coolgardie in Western Australia.

Powell and Burns' report on the effectiveness of a vacuum deaerator of the tray type in checking corrosion of a nine-mile pipe-line conveying Mississippi River water to the Freeport Sulphur Co. mining operations 50 miles south of New Orleans, at Grand Ecaille. This installation brought about 95 per cent reduction in the oxygen, the residual oxygen being 0.33 ppm. In order to have every assurance that this corrosion would be arrested, the residual oxygen was absorbed chemically by the proportioned introduction of sodium sulphite. It is interesting to note this installation was very successful, whereas chemical means tried previously were disregarded, because of their ineffectiveness or their cost.

Municipalities and large industries who have been depending upon the addition of chemicals for raising the pH value to arrest corrosion are now interested in the possibility of installing cold water deaerators. It is significant that in one industrial plant an installation has been made consisting of thirty units, having a total capacity of 90,000 gpm. These deaerators remove oxygen and carbon dioxide from demineralized water and are lined with rubber to prevent any possible contamination with iron.

Another installation having a capacity of 1650 gpm deaerates demineralized water to prevent corrosion in steel mains, heat exchangers, etc., where this water is to be ultimately used in a chemical process.

With the rapid advance of the chemical industry and the use of pure water for its requirements, the means of preventing process water from corroding steel, without chemical treatment, becomes obviously more necessary.

General Design of Equipment

Cold water deaerators, where heat is not applied, require the same essential conditions for their successful operation as the more familiar boiler feedwater deaerator namely:

(1) Maintenance of a pressure within the unit corresponding to the boiling point of the water under treatment.

(2) Means for dividing the water into small and minute particles in order to expose surface and to facilitate the escape of gases from solution while the optimum atmospheric conditions are maintained within the unit.

(3) Means for withdrawing the gases from the container after liberation and the maintenance of a constant vacuum condition.

While the Coolgardie and Freeport installations were successful in achieving their objectives, the design of such equipment has advanced considerably, and it is now possible to reduce oxygen and carbon dioxide down to a fraction of a part per million; eliminating the necessity of supplementary chemical treatment for absorbing the last traces of oxygen.

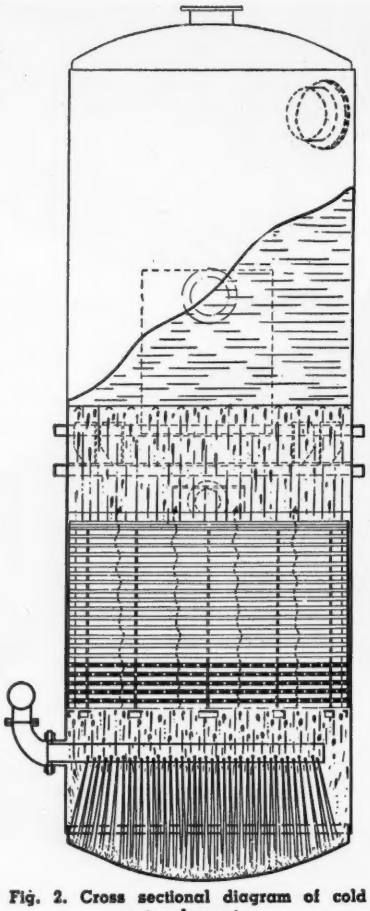

Fig. 2. Cross sectional diagram of cold water deaerator

In general the equipment is arranged so that water is introduced into the vacuum chamber through a spray pipe from which it is discharged in fine particles over a column of staggered trays, generally constructed of wood. The water cascades down these trays, which serve the purpose of distributing the water and breaking it into fine particles or films, permitting easy escape of the gases.

The non-condensible gases and a portion of the water vapor are withdrawn from the deaerator by means of vacuum-producing equipment which may take the form of steam jet ejectors, or mechanically operated vacuum pumps.

Where it is necessary to remove the gases to a very low degree, or to conserve on the size of the vacuum-producing equipment, and its cost of operation, deaeration may be accomplished in a multiple stage equipment in which the stages are sealed one from another in a common container, although they will be operated under different conditions of vacuum. Figure 1 illustrates such a design in which the water is deaerated when it passes through several stages.

Under certain conditions, these deaerators may be designed using a series of jets rather than trays, particularly so, if the water contains considerable suspended matter, but in most cases the water is naturally soft or made so by chemical process so that the trays are the preferred method of design.

While the common use of the cold water deaerator is new, in it is embodied the same principles of deaeration that have been so successfully used in the design of deaerators for boiler feed service. This type equipment, however, does present a relatively new application for industrial and municipal service, and it is quite likely by its more extended use, it will result in considerable economy by saving chemicals and principally by protecting steel piping and equipment from rapid deterioration. By so doing the capacity of the piping will be unaffected, irrespective of its age, making it possible with this equipment to install smaller sizes, because it will no longer be necessary to allow a capacity factor for accumulation of rust deposits after considerable use.

Piping Resistant to Soil Corrosion

In 1922, the U. S. Bureau of Standards started a study of the corrosion of pipe lines in typical soils throughout the United States. Data collected to date, gives a general indication of what may be expected of a considerable variety of alloys when exposed to severe soil conditions. The addition of very small percentages of alloying elements does not have a marked effect on the rate of corrosion, but rather large percentages are apt to bring about a considerable improvement in corrosion resistance.

Steels high in nickel and chromium, and copper alloys high in copper are very resistant to nearly all soil conditions. Lead corrodes only slightly after it acquires a coating of an insoluble lead salt.

Bursting and crushing tests indicate that asbestos-cement pipe gained somewhat in strength during exposure to the soil for 4 years.

A 3-ounce coating of zinc added about 3 years to the life of steel exposed to some of the most corrosive soils in the test sites. Lead coatings appear to be inadequate for severe soil conditions.

Several thick experimental coatings prevented practically all corrosion at most of the test sites for 9 years. Air-dried Bakelite coatings blistered within 4 years, and baked-on Bakelite coating blistered in a few places; otherwise it showed no change in appearance after this length of service. Pitting occurred under some of these blisters. Most thin coatings blistered, became brittle, and permitted rusting and pitting of the metal within 4 yr.

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Preventing Corrosion in Condensate Return Lines

Use of cyclohexylamine for preventing CO_2 corrosion in steam heating system return lines discussed by A. A. Berk of U. S. Bureau of Mines* . . . Action of amines in corrosion prevention . . . Practical control of cyclohexylamine treatment . . . Tests on typical heating system

CORROSION OF PIPING in steam-heating systems results usually from carbon dioxide and oxygen dissolved in the condensate. In some instances sufficient oil may be injected into the steam to coat the piping and thus help to separate metal from condensate, but such measures are not always successful where the condensed steam is returned to a boiler.

Severe corrosion experienced at Government-operated steam-heating plants, especially those at army camps, has led to the use of amine treatment at many locations. The amine used practically exclusively up to the present time has been cyclohexylamine. Corrosion has been conspicuously reduced; but in many cases the cost of the treatment was found to be excessive. An investigation of the process is being made, therefore, to increase its effectiveness and reduce its cost.

Amines for prevention of return-line corrosion, act like alkaline carry-over. Hence it appears that supplying the amine at a rate sufficient to provide for a continuous pH of 7.0 in the condensate should offer practical control of corrosion troubles. Excessive amine is not only expensive but also may lead to undesirable reactions on valve metal and packing.

Without amine treatment, carbon dioxide in the condensate is mostly free CO_2. As such it prevents the effective further solution of the much larger quantity of gas remaining in the steam space. Gas uncondensed is usually vented. Moreover, some of the carbon dioxide already dissolved may afterward be lost from the condensate as it passes through flash tanks, since an equilibrium tends to be established between free CO_2 in the liquid and vapor phases. In such cases, only a small portion of the carbon dioxide originally present in the steam ordinarily returns to the boiler with the condensate, the free carbon dioxide is neutralized. There is then no barrier but the time factor to complete solution in the condensate of all the CO_2 in the steam. Consequently, enough amine must be used, not only to be equivalent to the carbon dioxide normally present in the condensate but to all the carbon dioxide present in the steam.

*Abstracted from Bureau of Mines Report of Investigations 3754

Limitations of the Amines Now Available

The amines now available for use are not ideal, in the sense that their properties are not perfect for the alkalizing treatment. Some are not sufficiently volatile from boiler water, and to provide the proper concentration in the steam it is necessary to maintain 10 to 20 times that concentration in the boiler water. Blow-down water in such cases would contain very high concentrations of amine, causing the treatment to be expensive for the average plant.

Other amines are so volatile that they leave the boiler water practically instantly. With such substances there would be no losses in the blow-down, but amine would escape at vents in the system.

Cyclohexylamine

Cyclohexylamine is an organic compound in which one of the hydrogen atoms of ammonia is substituted by the cyclohexyl group.

The pure amine is a water-white liquid with a strong fishy odor. It boils at 276 F. but has the peculiar property of forming with water an azeotropic or constant-boiling mixture which boils at 206 F. It must be handled with care in the concentrated state, since the vapors are inflammable. The compound has also been reported to produce skin sores when handled carelessly.

Water solutions of cyclohexylamine are alkaline. The amine is more strongly basic than carbonic acid is acidic, so that when chemical equivalents of the two are mixed the solution of amine bicarbonate formed is not neutral but slightly alkaline (pH of 8.1).

Practical Control of Treatment with Cyclohexylamine

Cyclohexylamine treatment to prevent return-line corrosion should be successful if enough amine is introduced into the steam system so that the condensate is at a minimum of pH of 7, as measured at room temperature. Treatment to produce much higher alkalinities is unnecessarily expensive and in extreme cases could lead to undesirable results. A simple and practical control method, for use and interpretation by the boiler-room staff in the field, is fully described in the paper.

After considerable laboratory study, a series of tests was made to determine amine concentrations at several points in an operating steam system while cyclohexylamine was being fed to produce alkalinity in the condensate returns. The system was supplied with steam by one 400-hp Wickes boiler. Steam is generated at 100 psi but is used directly at this pressure only in certain circular corridor heaters. Each of the many buildings is equipped with its own pressure reducer, safety valve, traps, and flash tanks. Most of the latter are vented.

Condensate from the flash tanks is piped to centrally located collecting tanks, whence it is returned intermittently to the boiler room by pumps. Since there are several paths in the piping system and the time of retention of condensate in the tanks is uncertain, it was impossible to determine the length of time required for steam leaving the boiler to be returned to the boiler room as water.

Returning to the boiler room, the condensate enters a large, horizontal storage tank mounted above the deaerating heater. The tank, which is of several thousand gallons capacity,

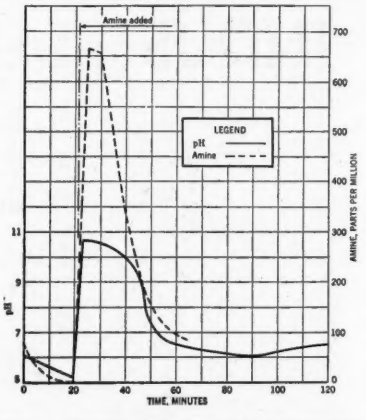

Fig. 1. Curves from Test 4, showing pH and amine concentration in steam

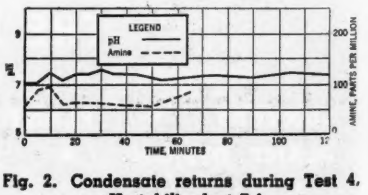

Fig. 2. Condensate returns during Test 4, pH stabilized at 7.4

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is generally somewhat less than half full. When the water level drops so that the tank is about one-third full, cold, untreated water is introduced automatically.

A float valve in the heater regulates the supply of water from the tank. Steam to the heater was maintained at a back pressure of 4 psi. The feedwater pumps supply deaerated water to the boiler in accordance with the steam demand.

A special compartment at the intake to the pump permits the introduction of chemicals directly to the boiler. Cyclohexylamine in a 60 per cent solution was fed in proportion to water flow in this manner.

Untreated well water is used as make-up to the boilers. The boiler is internally treated with metaphosphate and quebracho extract. The boiler water generally contains a hydroxide concentration of about 100 ppm OH, a phosphate concentration of about 30 ppm PO_4 and a definite tannin color. The boiler is blown down when the density of the water corresponds to more than 3000 ppm dissolved solids.

Sampling

Condensate returns were sampled at the vertical pipe leading to the storage tank. Steam leaving the boiler was sampled from the auxiliary header supplying the feed pumps. An arrangement of valves and piping permitted sampling of the vapor effluent leaving the vent of the deaerating heater. A sample of steam was also taken 1100 ft from the boiler room on a low-pressure steam pipe.

Tests were begun about 15 min before make-up amine was added to the boiler, and samples were drawn from the condensate and the two steam sampling points at 5-min intervals. Three samples of the vapor at the deaerating-heater vent were taken at 15-min intervals. A sample of boiler water was obtained 30 min after the amine was added. Ordinarily tests were run for 85 min.

Test Results

Figure 1 (Test 4) shows how pH and amine concentration in the steam from the boiler varied during the first run under stabilized conditions. The feedwater pumps were stopped for 10 to 15 min just before amine was added and its concentration in the steam dropped to zero. Treatment was then injected quite rapidly, and an unusually high amine concentration of 660 ppm resulted in the steam. Following the addition of the amine, samples of condensed steam were alkaline for about 30 min.

Figure 2 (Test 4) shows that the pH of the condensate returns during the above run was between 7.2 and 7.6. Amine concentrations were between 60 and 110 ppm while the total carbon dioxide (free plus combined) in three determinations averaged 34 ppm. Previous to this run, the deaerating heater had been taken down and cleaned. It was replaced with reconditioned valves to permit operation at temperatures above the atmospheric boiling point, making possible better removal of carbon dioxide from the boiler feedwater.

Figure 3 (Test 7) shows how the addition of 1 quart of 60 per cent amone affected pH and amine concentrations in the steam at both sampling points when the pH of the condensate returns had been adjusted to 8.1-8.5. The pH and the amine concentration reached maxima of 10.4 and 600 ppm, respectively. Maxima at the two sampling points occurred about 5 min apart, indicating that the steam moved quite rapidly through the main.

Higher total carbon dioxide concentrations at the point 1100 ft from the boiler may indicate that there were carbon dioxide pockets in the steam line. On the other hand, it is possible that only a fraction of the carbon dioxide in the steam is condensed with the sample and that the amount depends on the mechanics of sampling as well as on the alkalinity of the water. At the low-pressure (10-psi) line, conditions may be more favorable for condensing carbon dioxide.

Discussion of Tests

Samples of boiler water, taken at various times after make-up was added to the boiler, were found to contain little or no amine. The highest concentration, approximately 2 ppm, was found when the condensate returns had an average pH of 9 and an average amine content of 160 ppm. In contrast, sample of condensed vapor from the deaerating-heater vent contained as much as 830 ppm amine. The latter samples also contained high concentrations of total carbon dioxide, in some cases 700 ppm. No ammonia was found in any of the samples of condensed steam.

These data show that batch feed of the cyclohexylamine treatment creates high concentrations in the steam system momentarily but does not continuously provide for an alkaline condensate in traps and radiators. Inasmuch as the nipples from such units are generally the points at which corrosion is most severe, it is desirable to feed the treatment continuously. There are no indications at present that periodic high concentrations have any special usefulness in preventing corrosion, other than to decrease the period of time during which the steam is acidic. Momentarily high concentrations of amine may also be undesirable where the steam is used for direct-contact cooking and similar processes.

Increasing the temperature of the water in the heater from 210 to 220 F did not appear to affect greatly the volatility of the amine but did cause considerably more carbon dioxide to be driven off. To provide for a minimum concentration of carbon dioxide in the feedwater, it would appear that the deaerating heater temperatures should be as high as possible.

No ammonia could be found in the steam or in the return cendensate. Cyclohexylamine can therefore be used without break-down in a steam system operated at 100 psi. The chemical is probably stable at considerably higher pressures.

Losses of the voltaile amine probably occur at every vent in the system. Large quantities of the chemical were found in the vented vapors from the deaerating heater. Loss was negligible in the blow-down water but appreciable in the condensate that was not returned to the system.

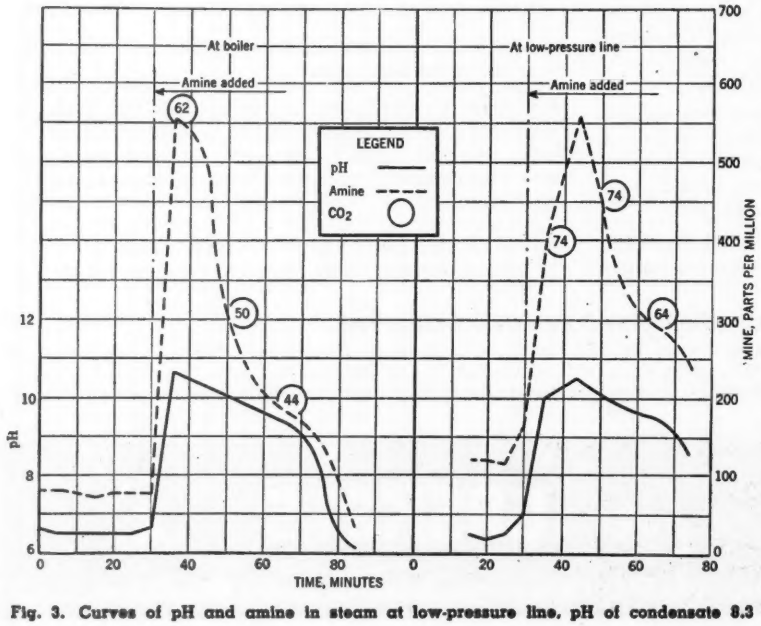

Fig. 3. Curves of pH and amine in steam at low-pressure line, pH of condensate 8.3

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Compressed Air in Glass Production

From the combustion of fuel to melt the glass to the handling of plates, drilling, etching, and hardening the product, compressed air application has solved many problems in the sheet glass industry

HUGE QUANTITIES of compressed air are used around the modern glass manufacturing plant, particularly in its applications for combustion, cooling, cleaning and lifting. It is, however, in the lesser known applications that compressed air gives emphasis to its flexibility, according to a report from the Educational Committee of the Compressed Air Institute.

It is understandable that glass sheets require special handling. Whereas the steps followed in turning out a sheet of glass are simpler and faster than the steps followed in producing a sheet of metal, the product itself is not as easily handled and many improved methods are now in use to shorten the labor of production and also to minimize the spoilage or breaking of the finished sheet.

Compressed air has come to mean more and more to the modern glass maker for it has ably solved some of the most troublesome production problems.

Basic to glass making, of course, is the furnace—much like the open hearth furnace of the steel mill. Unlike steel production, however, there is no intermediate step between the glass furnace and the glass sheet.

As an integral part of the furnace, where silica and other ingredients are heated into a molten mass, are rollers through which that mass is extruded out onto a flat surface—the beginning of a continuous strip of flat glass of a thickness and width according to the length and setting of the furnace rollers.

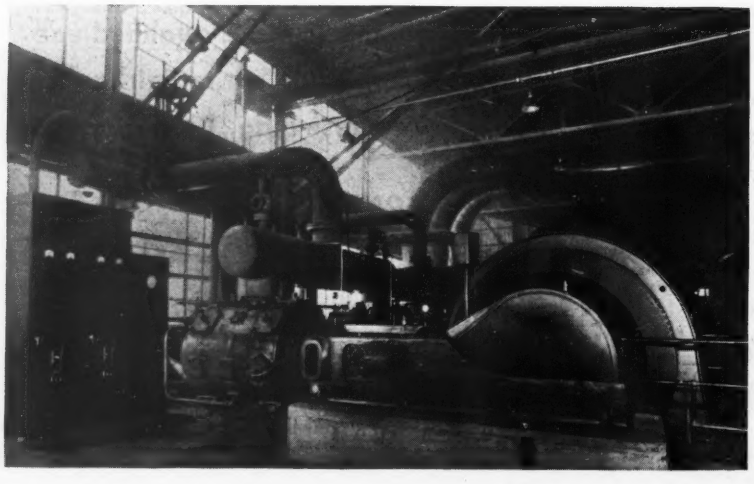
Air for Combustion

The furnace itself utilizes great quantities of air, generated by compressors or blowers with two to three pounds per square inch pressure capacity. This combustion air represents one of the most vital applications of air compressors. It is used to supply oil burners with air as well as to boost gas pressure for greater combustion efficiency.

Along the production line compressed air is utilized for lifting, for the cooling of rollers, for blasting holes and for etching.

Glass sheets are lifted from flat positions by vacuum cups operated by air compressors used as exhausters. This method of lifting has greatly reduced the danger of breakage since it does not permit excess strain on any one area of the surface. The vacuum lifts are adequately distributed over the surface so that stress failure cannot concentrate toward an unsupported part of the sheet.

The cooling of rollers along conveying lines is accomplished by circulating air through the inside of the rollers. Low pressure lines from compressors delivering approximately 2 lb pressure are utilized in this application.



Motor driven air compressor, typical of many used in the glass industry

Drilling and Etching

More dramatic, perhaps, yet a practical adaptation of compressed air is the boring of holes through glass sheets by means of abrasives or sand mixed with high pressure air. Special nozzles are adapted to air pressure of from 80 to 100 psi for this work. Holes are thus blasted through at only a fraction of the time required to drill them mechanically.

Etching glass surfaces is becoming more and more a job for compressed air. Special abrasives, selected for special results, are thrown with high velocity against the glass surface by means of compressed air. Automobile windshields illustrate the result of this type of etching. The small trade name seen in one of the lower corners of these windshields is etched by compressed air. A suitable mask containing the design to be etched is placed over the desired position and the compressed air and abrasive blast completes the job in a fraction of a second. Accuracy, uniformity and speed make this operation highly desirable in today's mass production. Producing uniformly rough surfaces by means of air blasting is another operation which has advanced the techniques and efficiency of glass making.

According to the Compressed Air Institute, many other compressed air applications are common to the glass manufacturing industry.

In one operation, where many polishing wheels are operating at the same time on a continuous glass sheet, automatic air operated lifts are a part of each grinder. In the event of power failure which would interrupt these polishing machines, the air operated lifts automatically raise the polishing machines at the instant of power failure. The lifting can also be operated manually when desirable.

Hardened Glass

One of the newer types of sheet glass, commonly referred to as hardened glass, is processed by compressed air. In this operation the glass sheet is heated to a high temperature and while hot is subjected to blasts of cooling air from the compressor line. This cools the outside but leaves the inner part in its heated condition. Chemical changes occur due to this sudden confinement of a semi-molten inner portion and the nature of the glass assumes a very hard structure. This hardened glass will break but pieces out of such breaking are not sharp as in ordinary glass. This type of glass is said to have greater shatter proof qualities than laminated types and far greater tensile strength.

Glass manufacturing requires compressed air for operating control instruments of various kinds and for the maintenance of equipment shop where grinders, chippers, hoists, reamers and other hand operated tools are powered by compressed air for convenience and for efficiency.

DETRICK *sees it through!*

WHETHER it is an ordinary boiler furnace or a complicated new chemical process, Detrick can be relied upon to see to it that the furnace enclosure functions properly. In the field as on the drawing board Detrick engineers have gained a reputation for thoroughness, originality and the type of direction that gets things done.

Proof of this statement lies in the thousands of Detrick Walls and Arches that are today giving excellent service under conditions far more severe than originally contemplated by their designers.

A new 80-page book describes the construction principles learned during 30 years of concentrating on the problems of enclosing heat. Ask for your copy of "DETRICK FURNACE ENCLOSURES."

M. H. DETRICK CO.
111 W. Washington St.
Chicago 2, Ill.

MODERNIZE NOW

Now's the time to check up your furnace walls and arches. Be sure they are ready for the job ahead. Any repairs and modernizing should be done at once. A Detrick inspection now may avoid costly production delays later.

DETRICK

USE DETRICK INSULATION . . . PLASTIC or BLOC

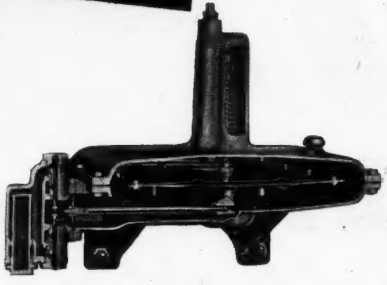
GREATER ECONOMY ALL THE WAY WITH MORE STEAM FROM LESS FUEL . . . .

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

FURNACE DRAFT CONTROLLER

. . . regulates the boiler up-take damper

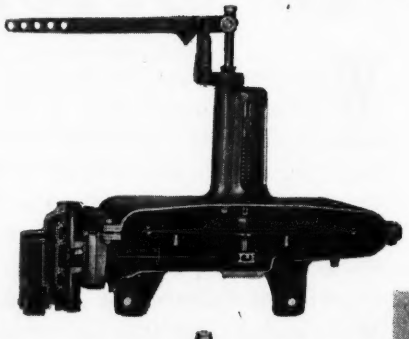
This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from over-fire draft, regulating the boiler up-take damper to maintain a constant draft in the combustion chamber. Place it near up-take damper. It works independently of either of the two Controllers shown below. It does its part toward money saving by eliminating wasteful air infiltration.



AIR FLOW CONTROLLER

. . . meters the air needed for combustion

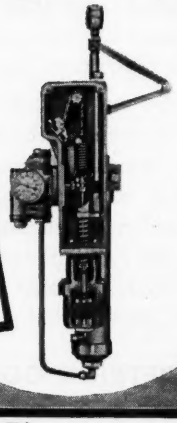
This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion. Comes with Operating Power Cylinder.



FUEL FEED CONTROLLER

. . . adjusts the rate of combustion

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving. Comes with Operating Power Cylinder.



There are numerous variations of each unit —combinations are easily arranged to best serve you. Write for Bulletin No. 300.

A. W. CASH COMPANY
DECATUR, ILLINOIS

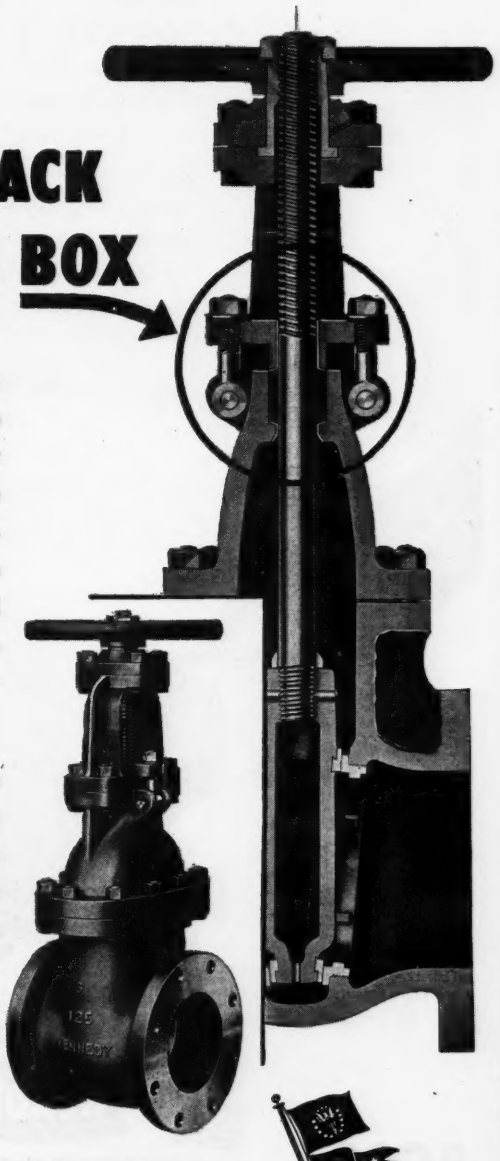
CASH STANDARD CONTROLS . . VALVES

"Trifles make perfection but perfection is no trifle"

"You pack up your troubles"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

WHEN YOU PACK THIS STUFFING BOX



Just check all the conveniences at the stuffing box of this Kennedy Standard O.S. & Y. Iron Body Wedge Gate Valve. Notice the swing bolts that drop out of the way for repacking, the slotted gland that frees the bolts after the nuts have been loosened, the washer type nuts that eliminate loss of washers, the shelves on the yoke to hold the gland out of the way, the bronze bushings at gland and bonnet where the stem passes through, and the generous depth of the stuffing box. The bolts and nuts are rust-proofed, too, so they will not corrode.

No wonder you can pack up and forget all your previous repacking annoyances and troubles when you install these valves. These many conveniences are typical of the careful attention to detail which you will find in all Kennedy valves and which makes it well worth while standardizing on them for your bronze and iron body valve requirements.

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK

KENNEDY

Extra Value in VALVES

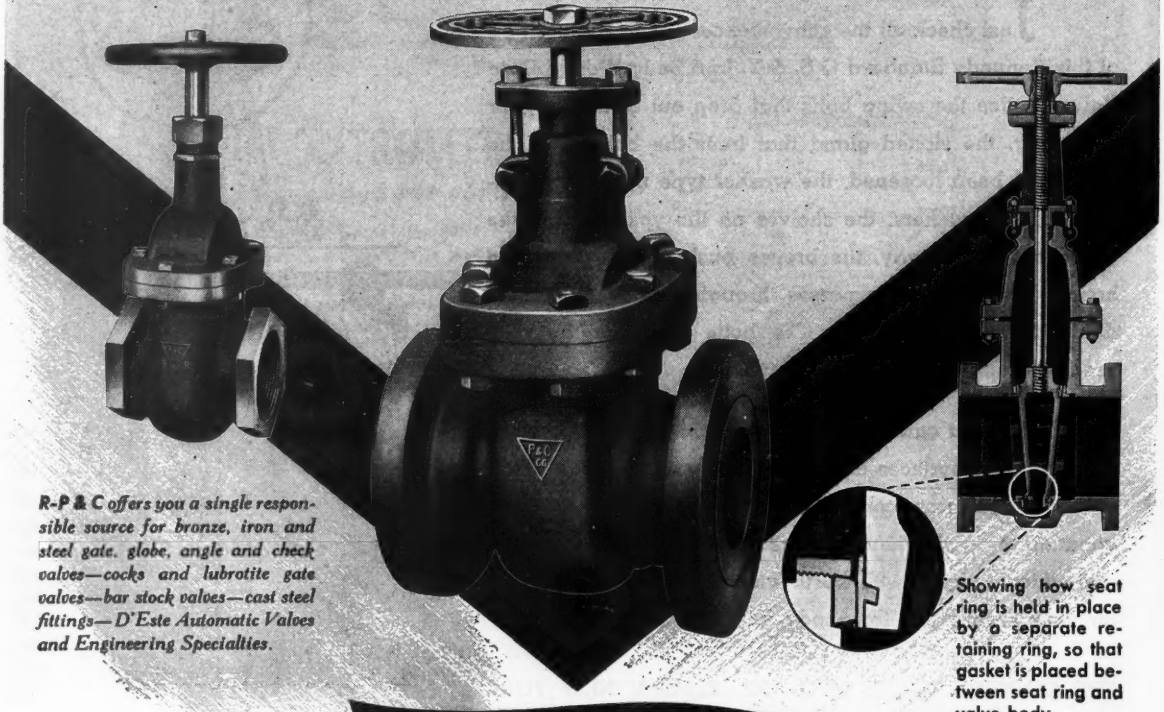
BETTER AND LONGER *Service* FROM *Gate* VALVES...

The retaining ring construction permits easy renewal of seats—with assurance of a good, tight job. This means a definite economy—especially in the larger size valves. But that is only part of the story.

The resilience afforded by the gasket between ring and body results in a more positive seal—better valve performance.

This retaining ring construction is exclusively a **READING-PRATT & CADY** development. It is typical of improvements in valve design constantly being made by **R-P&C** engineers, toward better valve performance and longer valve life.

Next time you have need for valves, get a recommendation from **READING-PRATT & CADY.**



***R-P & C** offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Valves and Engineering Specialties.*

Showing how seat ring is held in place by a separate retaining ring, so that gasket is placed between seat ring and valve body.

READING-PRATT & CADY

MANUFACTURERS OF

READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

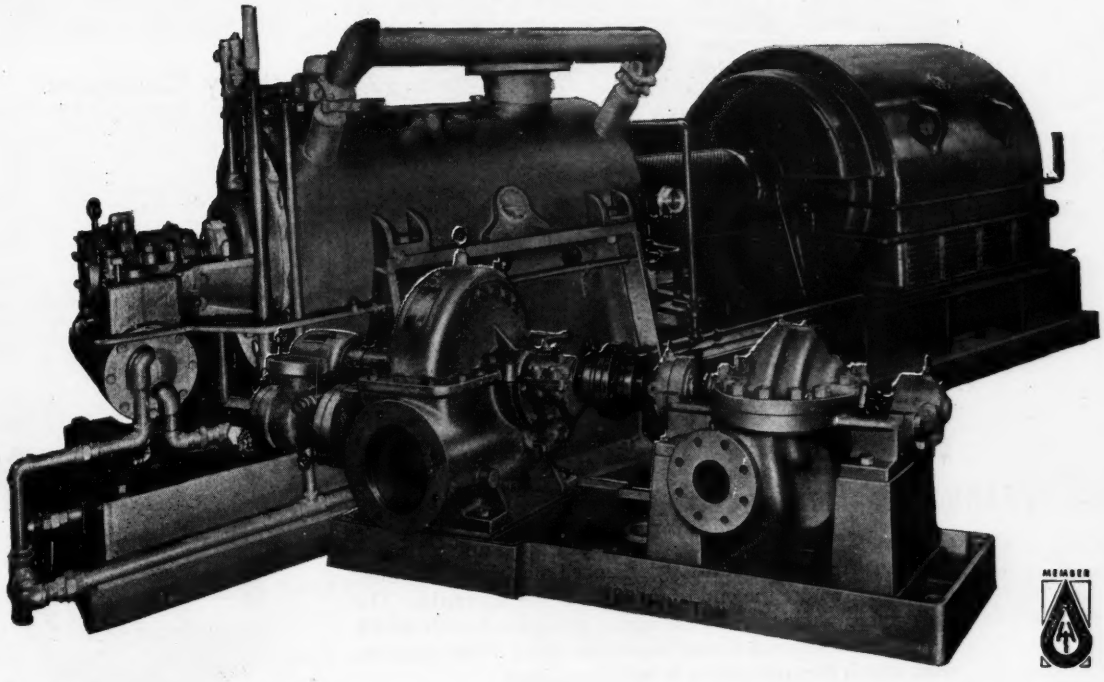
Reading, Pa. • Atlanta • Boston • Chicago • Denver • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

ACCO

TRADE MARK

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

WHAT MR. LITTLE LEARNED FROM MR. BIG



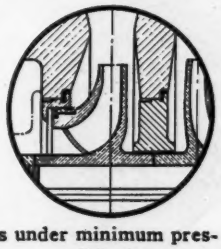
Explains Why Worthington Low Pressure Boiler Feed Pumps Give You More Value For Your Money

"Mr. Little"– the low pressure boiler feed pump – learned a lot at Worthington from high-pressure "Mr. Big".

The same pump engineering ability that built the first high pressure boiler feed pumps in the U. S. (above 1200 p.s.i.) . . . and made them able to operate 30,000 hours – and more! – without major or minor overhaul . . . built the low pressure centrifugal pump (type UB2 – 150 to 500 p.s.i.) illustrated above.

Investigate, in Bulletin W-318-B11B, its many advantages. Find out how *balanced design* eliminates end thrust . . . how *"elastic seal"* rings prevent interstage leakage . . . how its *rigid center support* prevents misalignment from expansion. Write us, or telephone our nearest district office. *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

WORTHINGTON'S "ELASTIC SEAL" RINGS PREVENT PUMP TROUBLES BEFORE THEY START



Interstage leakage (a common cause of pump breakdowns) is definitely ended with Worthington's exclusive "Elastic Seal" Rings on the job.

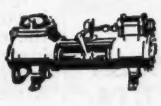
Other low-maintenance construction features: accessible, horizontally-split casing . . . both stuffing boxes under minimum pressure...simple rotor construction...no diffusion vanes.

WORTHINGTON *BEHIND THE NAME* WORTHINGTON

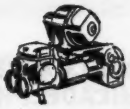
CP4-19

WORLD'S LARGEST MANUFACTURER OF PUMPS

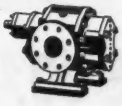
STEAM



POWER



ROTARY



VERTICAL TURBINE

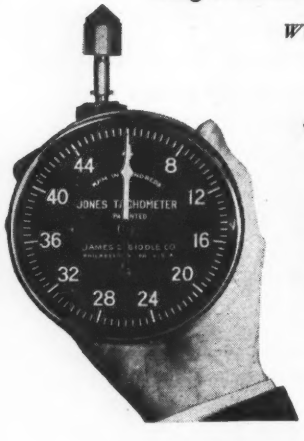
CENTRIFUGAL

The "FRAHM" VIBRATING-REED HAND TACHOMETER . . .

requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine with which the instrument is held in contact.

For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 to 30,000 r.p.m.

Write for descriptive Bulletin 1590-P.E.



The JONES HEAVY DUTY HAND TACHOMETER

is used for indicating r.p.m. and surface speeds of all types of machinery in which the moving parts are readily accessible. Simple, rugged and reliable, it is built to maintain accuracy in hard, everyday service. Single and triple-range models up to 12,000 r.p.m. supplied complete with carrying case and accessories.

Write for descriptive Bulletin 1710-P.E.

. . . The JAEGER SPEED INDICATOR

is a "vest-pocket" speed-measuring device which adds up the number of revolutions over a period of six seconds and shows the revolutions per minute without any calculations. Can also be used to measure speeds in feet per minute. Available in two models—for all speeds up to 2000 r.p.m. and for all speeds up to 10,000 r.p.m. Supplied complete with carrying case and accessories.

Write for descriptive Bulletin 1750-P.E.

JAMES G. BIDDLE CO. **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

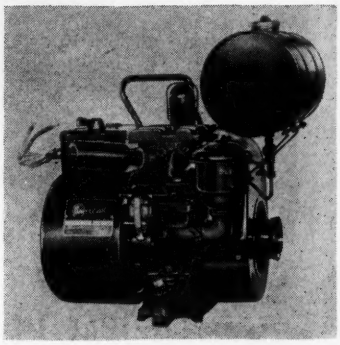
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Battery Chargers

UNIVERSAL MOTOR CO., 419 Universal Drive, Oshkosh, Wis., has announced the development of two new battery charging light plants: Model 256-GH, 6 v dc, 250 watts; and Model 312-GH, 12 v dc, 300 watts. They replace electric light plants of similar size as furnished by Universal prior to the war.

Both plants are driven by single cylinder, four cycle, air cooled gasoline engines. Generators are mounted integrally to the engines with provision for electric starting. A control



box mounted on the generator features a switch with "Start" and "Neutral," also "High" and "Low" charging positions, automatic battery cutout, ammeter, and battery lead wires.

The plants are completely equipped. Air cleaner, one gallon gasoline tank, gasoline filter, and muffler are mounted. A float feed carburetor and enclosed high tension magneto insure efficiency operation from the first start. Proper engine speed is automatically maintained by governor.

Extremely compact and weighing only 72 lb, these new models are particularly suited to portable service and many industrial applications

Oil-Tight Pushbuttons

INTRODUCTION OF A NEW line of Class 9001 Type T Oil-Tight Pushbuttons, designed primarily for group mounting on machinery or control enclosures has been announced by Square D Co., 4041 N. Richards St., Milwaukee 12, Wis. While oil-tightness is the principal feature of this new line, several other worthwhile advantages are noted. Although the new Type T units are more compact and can be mounted on closer centers than previous types, there has been no sacrifice of accessibility. All terminal screws can be reached with a screw driver without going in at an angle.

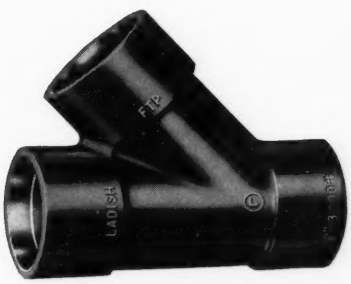
Quick, easy installation is another important advantage. As shown in the exploded illustration, the unit is inserted through the panel and prevented from turning by a dowel. After the legend plate is slipped on,

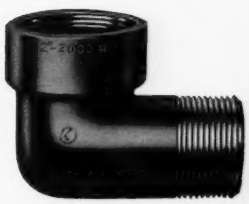
CARRYING ON THE TRADITION OF

Controlled Quality

To users of Ladish Forged Steel Fittings the tradition of Controlled Quality means added stamina—the assurance of dependable performance on pressure piping applications.

Produced under the same exacting metallurgical controls which characterize all Ladish products, Ladish Fittings also bear the authentic symbol of Controlled Quality identification—the Ladish Heat Code.





BUY . . and hold . . WAR BONDS

ARMY E NAVY

FITTINGS DIVISION

TO MARK PROGRESS

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

MILWAUKEE SUBURB

District Offices: NEW YORK CITY • PITTSBURGH • CLEVELAND • ST. LOUIS • HOUSTON • LOS ANGELES

Every Office Needs a Salvage Chief

"appoint yours today!"

Uselessly stored in many American offices today are tons of *war material!* Vitally needed paper — the raw stuff of blood plasma boxes, shell cases, supply parachutes — *V paper!* It takes many forms . . . dead files, old correspondence, records.

It's easy to put off getting that paper together, bundling it and turning it in. But you should do it for the war effort and for your own sake. Only in this way can we help avoid further civilian paper allotment cuts.

That's why every office should appoint *one person* to act as Salvage Chief. He — or she — can organize the effort, and arrange for regular Paper Salvage days. And the Salvage Chief can remind everyone to adopt conservation measures — to use less paper — as little as possible.

Many organizations which sell their waste paper turn part of the funds over to buy little extras for wounded veterans, or to support some other worthy community project. Thus you have a chance to make your paper serve *twice.*

Get your office paper salvage program rolling *now!*

DOUBLE V PROGRAM

SAVE WASTE PAPER

V TO SPEED VICTORY
V TO AID VETERANS
OR LOCAL PROJECTS

Separate and tie in bundles: 1. Wastebasket scraps. 2. Corrugated boxes, brown paper and bags. 3. Magazines and books. 4. Newspapers.

This advertisement prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information. Space contributed to Double V Waste Paper Program by this publication.

Light is always green at POWELL

At Powell, scientific study, research and experimentation *never* STOP. That's why Powell Engineering has always been able to solve the intricate flow control problems imposed by new products and processes.

Add to this our non-stop application of lessons learned through 99 years of practical experience and you have the Powell Line—a complete line of valves of every type and material needed to satisfy all flow-control requirements of industry today. And tomorrow, as new demands arise, there'll be Powell Valves to meet them.

Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Also available with taper wedge double disc—Fig. 1444.

Fig. 256—Iron Body Bronze Mounted Globe Valve for 250 pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke, and regrindable, renewable bronze seat and disc.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

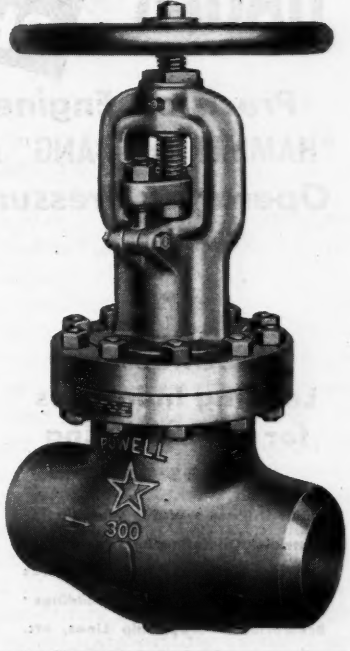
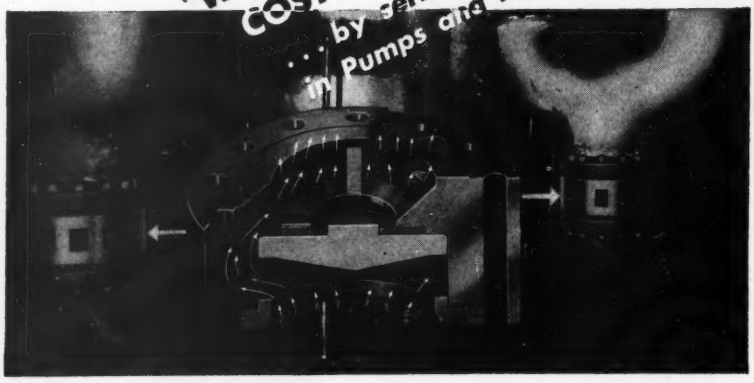


Fig. 3031 WE—Class 300-pound Cast Steel Globe Valve, with welding ends, outside screw rising stem and bolted flanged yoke.

"WATER HAMMER" COSTS YOU MONEY!
. . . by serious breakdowns in Pumps and Piping Systems



WILLIAMS-HAGER FLANGED Silent CHECK VALVES

Precision Engineered to Eliminate "HAMMER and BANG" in ANY system with Operating Pressures up to 6,000 lbs.

Heavy duty service records upwards of 17 years without removal from lines . . . Williams-Hager Flanged Silent Check Valves are built to meet the exacting requirements of any end use. No webs to restrict or hamper the flow of liquids . . . the free-floating valve will operate normally and efficiently in *any* position.

Dependably constructed in sizes from 1" to 20" inclusive, from iron, semi-steel, bronze, cast steel, stainless steel or monel . . . pressure resistant to 6,000 pounds.

Do you have the new Williams Catalog for Power Plant Equipment?

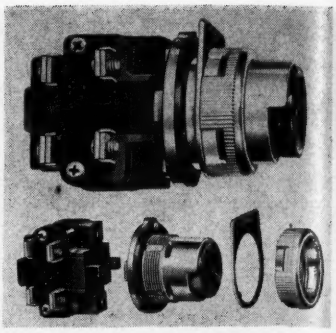
specified by Leading Industries for such exacting uses as:

Public Utilities • Water Works • Industrials • Oil Refineries • Paper Mills • Hotels • Hospitals • Chemical Works • Office Buildings • Public Buildings • Breweries • Steamship Lines, etc.

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 PENNSYLVANIA AVENUE • PITTSBURGH 12, PA.



a thread ring firmly clamps the unit into position.

Still another feature is the unusual flexibility of the new line. Since the operating mechanism and the contact block are separate units, it is possible to obtain a combination to cover a wide range of circuit requirements with a limited stock of three types of operators and four types of contact blocks.

New Lens for Peep-Holes

THE ESS INSTRUMENT CO. of Ft. Lee, N. J. has developed a new lens, for its Cat's-Eyes, to permit visual inspection of boiler furnace interiors and their contents, while in operation.

This new lens designated as "Type O" provides a wider field of vision with less reduction than is available through a standard type "G" lens. Both are interchangeable.

Cat's-Eyes equipped with Type O lenses will show, at a glance from distant points, the flame with its characteristics of color, turbulence and haze, and objects inside a furnace.

Steel Supported Smoke Stack

CHICAGO FIRE BRICK CO., 1467 Elston Ave., Chicago 22, Ill., announces the development of a new type of smoke stack called the "Durabilt" stack which is built like a skyscraper. It consists essentially of a hexagonal steel structure, adequately braced throughout its length to resist high wind load, shock, lightning and also earthquakes. Horizontal and vertical members are attached to the steel structure and these support anchor and tile retaining castings. Each tile forming the inner wall is individually retained. The outer tile is supported by means of channels at definite spacings. Any section of tile may be independently removed without affecting the other.

An outstanding feature of the stack is its insulation. This fits snugly and securely between the tile and retainer castings, providing low radiation loss and helping to keep temperatures within the stack uni-

STANDARD ENGINEERS NOTEBOOK

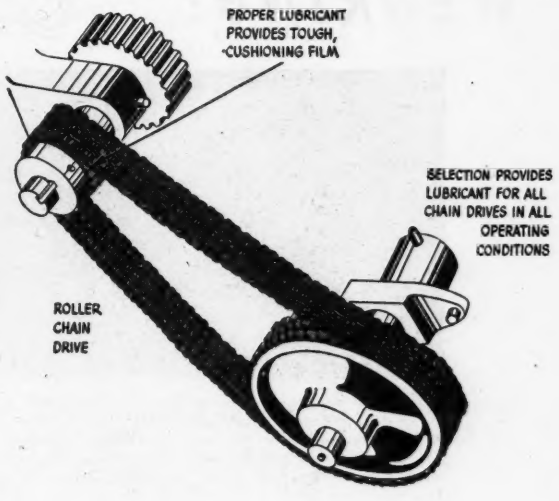
Correct lubricant reduces chain drive wear

Selection of the proper Calol lubricant for any type chain drive will materially reduce wear even under the most adverse conditions.

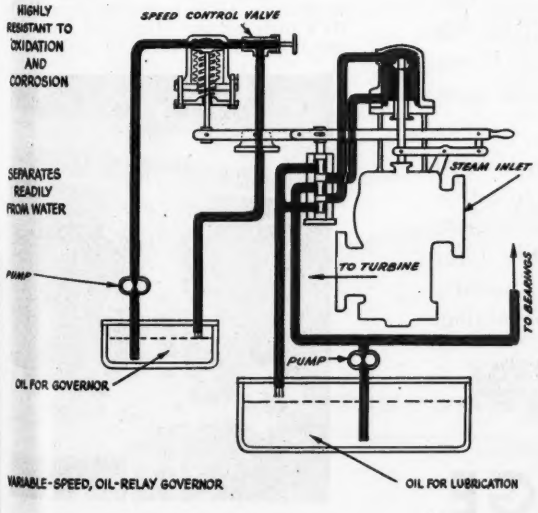
On a worm or exposed roller and block chain, Calol Pinion Grease—0 is recommended for high operating temperature, Calol Roller Oil—X for medium and Calol Journal Oil—135 for low. For enclosed chains of this type, Calol Journal Oil—165, —135 and —35.

For chains exposed to pitch, resinous materials, etc., special Calol Drier Chain Oil is recommended.

Recommendations for silent chain drives are as follows: Worn, exposed chains: Calol Roller Oil—X, high temperature; Calol Journal Oil—135, medium temperature; Calol Journal Oil—35, low temperature. New, exposed chains or oil-bath-lubricated encased chains: Calol Journal Oil—135, —35 and —25. Splash-lubricated, encased chains: Calol Journal Oil—35, —25 and —14.


PROPER LUBRICANT PROVIDES TOUGH, CUSHIONING FILM
SELECTION PROVIDES LUBRICANT FOR ALL CHAIN DRIVES IN ALL OPERATING CONDITIONS
ROLLER CHAIN DRIVE

Inhibited turbine oil lengthens charge life



Many operators have eliminated rust, gum-carbon and sludge trouble in hydraulic governors and turbine oil-systems by using Calol OC Turbine Oil.

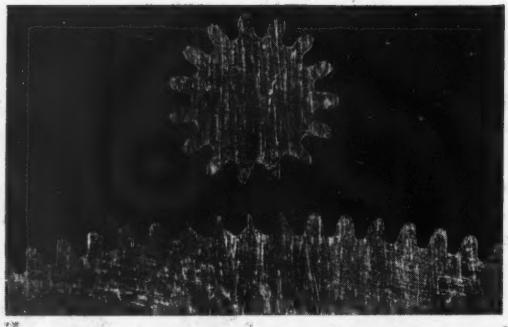
Made from highly refined, high viscosity index base stocks, Calol OC Turbine Oil is compounded with extremely effective oxidation and corrosion inhibitors. Because of high oxidation resistance, charges of this oil may be used much longer than charges of ordinary turbine oil. It prevents rust formation, particularly troublesome during the initial operation of turbine units, assures maximum lubrication safety and a minimum of time lost for maintenance.

Although it is primarily made for steam turbine lubrication, Calol OC Turbine Oil is adaptable to other operations where there is need for a high grade oil that will not deteriorate rapidly in the presence of high temperatures or moisture.

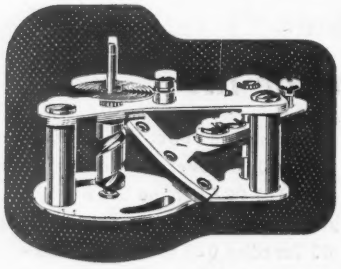
Calol OC Turbine Oil is made in five grades: —5, —9, —11, —15, and —19.

STANDARD OF CALIFORNIA

HOW ARE YOUR TEETH WEARING?



Here's what happened to the stainless steel gear teeth of a good conventional gauge movement after 500,000 cycles of operation at 1200 pressure pulsations per minute. In contrast — after 30,000,000 cycles, the cam facing of the *Helicoid movement* was merely burnished, and the accuracy of the Certified Gauge was unaffected. This was the result of a test made by an independent laboratory.



Only Certified Gauges are made with the Helicoid movement. This means there are no teeth to wear out or get sticky. The smooth rolling action of the Bakelite cam against the hard bronze roller practically eliminates wear.

HAVE you looked at the gear teeth in your pressure gauges lately? Are they so worn that your gauges are inaccurate and unreliable? If so, better replace with Certified Gauges to eliminate gear teeth trouble.

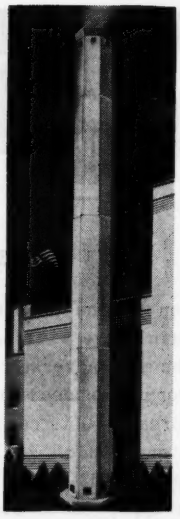
All Certified Gauges are guaranteed accurate to within ½ of 1%. They stay accurate longer. They are ideal for pumps, compressors, presses, turbines, etc. Send for catalog.

ARMY NAVY E

Certified GAUGE AND INSTRUMENT CORP.

Certified GAUGE

5-CG-2



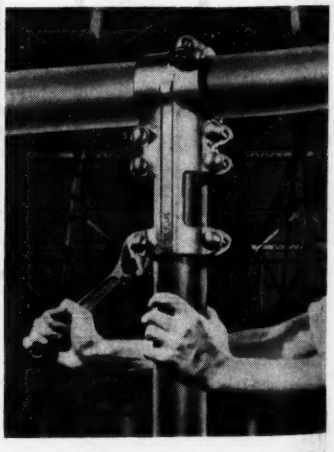
form, thereby increasing efficiency by improving draft.

Being sectionally supported, there is no cumulative load upon the fire brick lining. Less foundation is required and weight savings of approximately 33⅓ per cent are made possible.

The outer casing of the stack can be of tile, sheet steel, Transite, or waterproof material. Air space is provided between the insulation and outer tile throughout the stack. Vents are located at the bottom and top of sack.

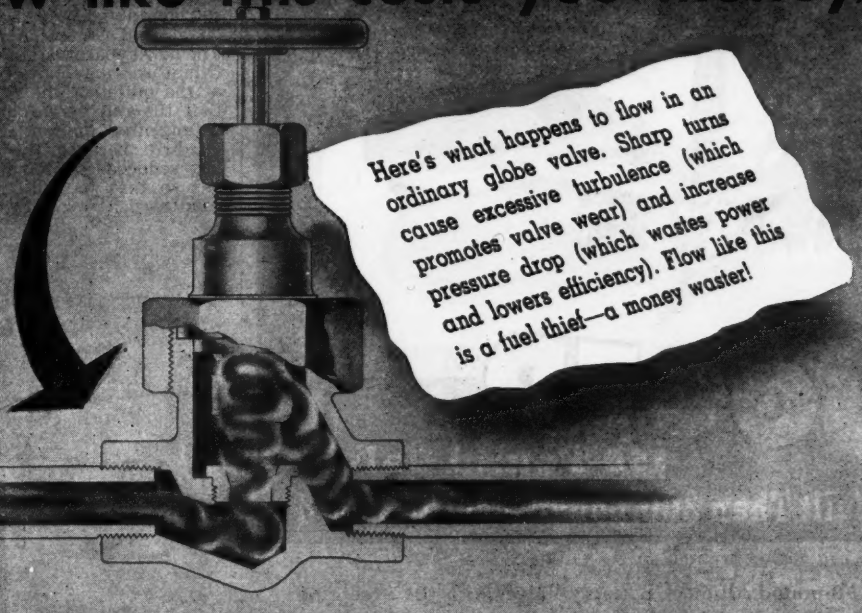
Alloy Cast Connectors

ADOPTION OF A NEW, high-strength alloy for all cast, current-carrying parts of electrical connectors has just been announced by the Burndy Engineering Co., Inc., 107 Bruckner Blvd., New York 54, N. Y. This alloy, known as Burndy 113L, is the same as Burndy's high copper alloy 113, but with the important addition of Lithium.



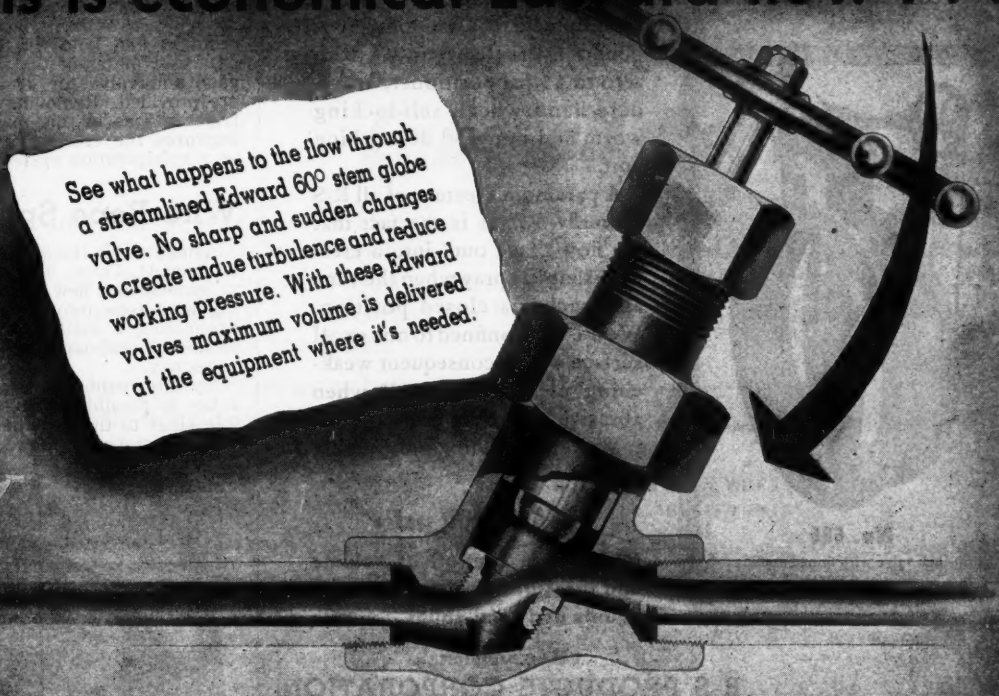
This addition of Lithium is said to provide a far denser and fine-grained casting, with an increase in tensile strength of almost 20 per cent. Elongation is also increased about 20 per cent. The co-efficient of friction is reduced, yet all these advantages are obtained without any appreciable change in electrical conductivity.

Flow like this costs you money . . .



Here's what happens to flow in an ordinary globe valve. Sharp turns cause excessive turbulence (which promotes valve wear) and increase pressure drop (which wastes power and lowers efficiency). Flow like this is a fuel thief—a money waster!

This is economical Edward flow . . .



See what happens to the flow through a streamlined Edward 60° stem globe valve. No sharp and sudden changes to create undue turbulence and reduce working pressure. With these Edward valves maximum volume is delivered at the equipment where it's needed.

Edward angle type valves have the same characteristics of economical, low pressure drop flow. You save money and increase operating efficiency by making your small globe and angle valves Edward.

EDWARD *Steel* VALVES

The Edward Valve & Manufacturing Co., Inc. • East Chicago, Indiana

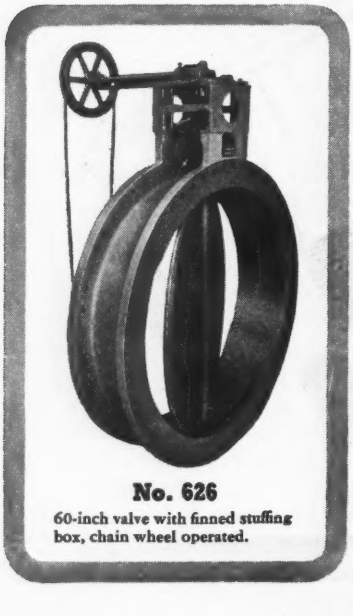
No. 633
Four to six revolutions of the hand wheel completely open or close the valve vane.
RUGGED
150-Pound Valve
Better Built Than 300-pound Steel Standard

This R-S 150-pound All-Steel Butterfly Valve, with the exception of the 150-pound raised face flanges, is actually better built than a 300-pound steel standard. Body, vane, shafts, keys, bushings and bearings far exceed 150-pound ASA requirements. Such rugged construction outlasts 150-pound pipe fittings.

Equipment consists of a 300-pound hydraulic cylinder with zero to 15 psi positioner, heavy-duty hand wheel, self-locking worm and gear and declutching unit.

A paramount feature of all R-S Butterfly Valves is the fact that the flow "fans out" into a crescent-shaped spray when the vane approaches a closed position. Wear is not confined to one small surface with a consequent weakening of the valve wall when abrasive materials are handled.

Write for details and Catalog No. 14-B.



No. 626
60-inch valve with finned stuffing box, chain wheel operated.

• 15 to 900 psi •

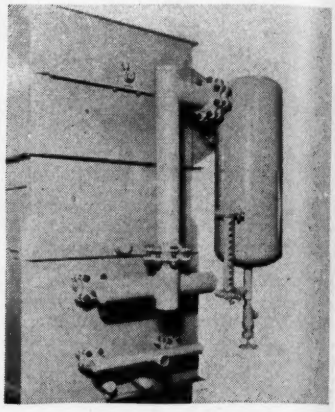
Control and shut-off of volume and pressure for air, gas, steam, liquids and semi-solids.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

Oil Remover

NIAGARA BLOWER CO., 6 E. 45th St., New York 17, N. Y., has developed a new method of removing oil from refrigerant gas as a part of the Niagara Duopass Aero Condenser. The new apparatus, called the Niagara Oilout uses a cylindrical drum located at the outlet of the Duopass Coil so that the refrigerant gas enters with a tangential motion. This method is effective because the Duopass Coil has reduced the temperature of the gas so that the oil vapor has been condensed.

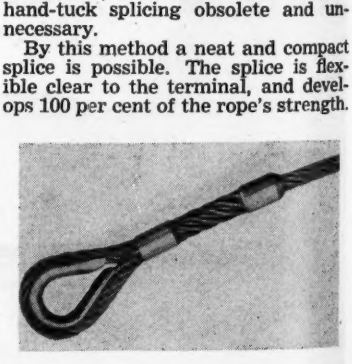


Expansion of the system from a 4-in. pipe to a 14-in. drum (in the model illustrated) reduces the velocity of gas so that the oil is easily removed and held by the wall and separator plates of the trap. A sight gage and valve for draining the oil are provided. Removing oil from refrigerant gas in this manner greatly improves the efficiency and capacity of a refrigeration system.

Wire Rope Splice

AMERICAN CHAIN & CABLE CO., INC., Bridgeport, Conn., announces the development of a new method for splicing wire rope into slings or various assemblies, a method which renders hand-tuck splicing obsolete and unnecessary.

By this method a neat and compact splice is possible. The splice is flexible clear to the terminal, and develops 100 per cent of the rope's strength.



The splice maintains equalization of stresses in all strands and applies the load stress in direct line with the pull of the load. It is wide open for visual inspection at all times and may be used with any standard fitting (hook, ring, shackle, thimble, etc.), and when the sling or assembly is retired such fittings may be salvaged and reused.

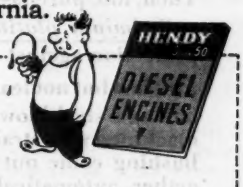
Phantom view shows lube-oil path in red

"Put DOWN that oil can, Lube-oil Reuben!"

No need to hand-oil any part of a Hendy Series 50 Diesel! It's completely enclosed, so *all* parts are oiled from the pressure-lubrication system . . . automatically . . . in correct amounts, neither too much nor too little.

Series 50 Diesels have advantages never before combined in a single design. Besides full pressure lubrication, they have overhead camshafts, unit fuel pumps and injectors, oil-cooled pistons, and many other features.

Now, for the first time, you can have the benefit of *all* these features in *one* tested and reliable Diesel. For complete information, mail the coupon today to Joshua Hendy Iron Works, Sunnyvale, California.



Send for NEW Diesel Booklet
No Obligation

JOSHUA HENDY IRON WORKS
SUNNYVALE, CALIFORNIA

Mail me your new booklet that completely describes the Series 50 Diesel, with photographs and cross-section cutaway drawings showing the design of all major parts.

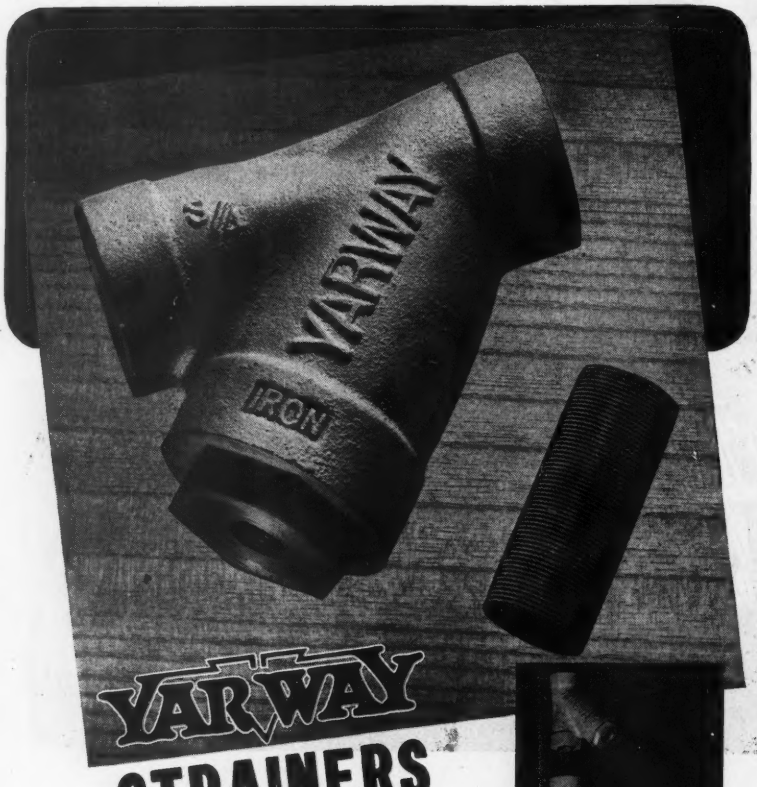
Name_____ Position_____

Company or business_____

Address_____

I'm interested in Marine ☐ Stationary ☐ Diesel-electric ☐ models and in hp ranges from 190-250 ☐ from 250 up ☐

100-D-17



STRAINERS "Police the Pipelines"

YARWAY STRAINERS are *selling by the thousands* because they are better engineered for the service.

"*The Screen is the Thing*"—a high-grade, woven Monel wire screen that stops the dirt, lets fluids flow freely.

Then, too, purchasers like the *body finish*—*Cadmium plating inside and out* for protection against corrosion.

And last but not least, it is "*Easy to Clean*" having a steel blow-off bushing, precision machined with straight thread. Screen and bushing come out together—go back together, automatically aligning.

Six sizes, ½" to 2" for pressures up to 600 lb serve practically all strainer needs.

Sold by over 100 Mill Supply Houses. See your Supply House or write for Bulletin S-200.

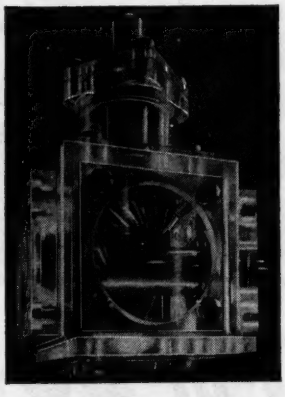
YARNALL-WARING COMPANY
114 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

Remote Mechanical Control Units

M. L. BAYARD AND CO., 1946 Indiana Avenue, Philadelphia 32, Pa., has developed a standardized system of remotely operated mechanical controls. The control system is used on such equipment as cranes, winches, windlasses and steering gears and for opening and closing large valves with motors, ventilators and for the operation of banks of furnace doors, and factory windows.

The related units are suitable for power operation under speeds not exceeding 1800 rpm. Terminal connections are constructed so that rearrangement of the same units can be made without disturbing the assemblies or affecting their internal adjustment.



The steady shaft assembly is engineered in two standard types. One is for attachment to surface which is square to the shaft, particularly suitable for deck, bulkhead, or any other water-tight mounting. The other is for attachment to surface which is parallel to the shaft.

Full freedom is possible with the spiral bevel gear assemblies (illustrated here) because all shaft ends are interchangeable. Either two shaft ends or three shaft ends, depending upon the type desired, are connected to other control units.

The Universal Shaft Assembly is made in lengths ready to be installed, or with one end yoke to be field welded after the tube is cut to suitable length. Telescoping splined portion between the end yokes permits ready installation and removal without disturbing the other control units.

Plug Cock Twin Strainer

ELLIOTT CO., Jeannette, Pa., announces the development of a plug cock strainer of compact, simple design and heavy, substantial construction which can be quickly and easily cleaned. The strainer is of the twin type, one side being always in service, while the other is cut out of service for cleaning the strainer basket. The change from one chamber to the other is made by moving the hand wheel to loosen the tight fit of the plug, then shifting the lever.

An arrow on the valve lever shows which compartment of the strainer

Is this one big enough for you?

★ *ASA Standards cover welding neck flanges only in sizes through 24". But the big boiler and pressure vessel people often require huge ones like this, and for more than 25 years Taylor Forge has been the leading maker of such flanges.*

Obviously, problems in connection with the design and fabrication of boilers and other pressure vessels are closely related to those in the piping field. We ought to know, for we've had a lot of experience in both.

YES, through the years we have tackled — and solved — a great many unusual problems. Each has added its contribution to our knowledge of what constitutes good piping design. Many have required the development of special forging techniques.

This accumulated "know-how" has been drawn upon fully in both the design and manufacture of our standard line of WeldELLS and other Taylor Forge fittings for pipe welding. It has resulted in fittings of advanced engineering design with features which add to their strength, service life and convenience—others that lower their installation cost.

Take WeldELLS for example, and check the list of features at the right. Are there any *you* would omit? Can you think of another you would add?

Most piping men today, we believe, will agree that:

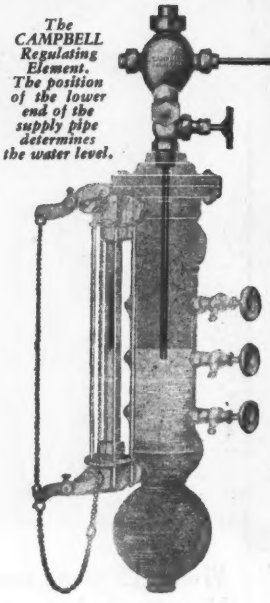
WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

WeldELLS *have everything*

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

CAMPBELL
Boiler Feed Water Regulator



The CAMPBELL Regulating Element. The position of the lower end of the supply pipe determines the water level.

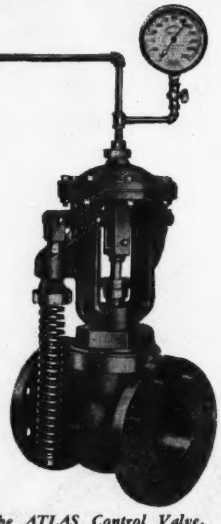
NO FLOATS

NO THERMOSTATS

NO GENERATORS

NO LINKS

NO MOVING PARTS



The ATLAS Control Valve. It may be placed at any distance from the regulating element. Controls large water lines as easily as small. No pressure limit. No capacity limit. No sticking. Dirt and scale make no difference.

The Campbell saves labor, saves fuel, eliminates trouble, and insures proper water level in any boiler, regardless of size.

We can't tell all about the CAMPBELL in this space, so, ask for complete data. For instance, we have a pamphlet which gives "17 Reasons Why the CAMPBELL Is Preferred by Boiler Operating Engineers." Reason No. 16 is: "The money saved by the use of the CAMPBELL in the course of a year is usually much more than enough to pay the first cost of the entire installation." There are 16 other reasons. Ask for them.

In addition there are other ATLAS products, listed below. Check those items on which you want data and mail to us with your name and firm address.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

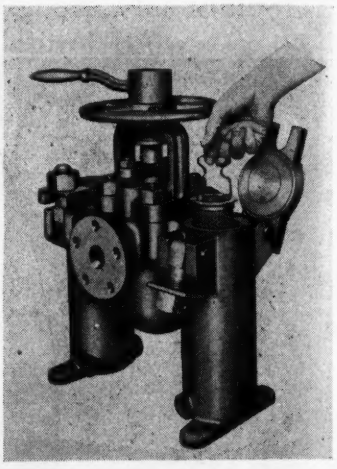
Specialists in Regulation for Nearly a Half Century

291 South St., Newark 5, N. J.

Representatives in Principal Cities

☐ **Please send complete information on the CAMPBELL Boiler Feed Water Regulator. Also please send information on the following Atlas products—**

☐ Damper Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control Systems
☐ Pressure Regulators
☐ Pump Governors
☐ Float Valves
☐ Oil Control Cocks
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves



is in service. The valve lever also serves a wrench to loosen the door bolt nut. With the bolt swung down and the door turned back, the strainer basket is easily removed for cleaning. Arrows on the hand wheel clearly indicate how to turn it in order to loosen or tighten the plug.

Designed for use on either oil or water, and for suction or discharge service, the new Elliott plug cock strainer is available in steel, cast iron or bronze, depending upon service requirements.

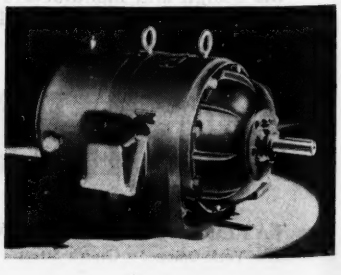
Water-Service Packing

GREENE, TWEED & Co., Bronx Blvd. at 238th Street, New York 66, N. Y., has announced the development of a general utility lubricated centrifugal pump packing known as Palmetto Plaited Packing. In this packing, long-fiber asbestos yarn is used instead of cotton, with the advantage that the packing can be used for hot water as well as cold water. The lubricant is Palmetto Graphite grease. This lubricant is applied by a process which thoroughly impregnates every individual fiber of the packing.

The packing is plaited in square form, and is made in a wide range of sizes. Equipment for which this packing is recommended includes centrifugal pump shafts, reciprocating pump rods and plungers, valves, fire hydrants, and other apparatus handling hot or cold water.

Explosion-Proof Motor

GENERAL ELECTRIC Co., Schenectady 5, N. Y., has announced the development of a new Class I, Group C, explosion-proof motor, for atmospheres containing ethyl-ether and similar vapors. It is recommended by



Baffles check erosion of heater tubes

TUBES were failing in a horizontal chemical heater after three years of service, yet similar tubes in a vertical heater showed no corrosion after 13 years. Steam enters the top of the shell at one end under 38 lbs. pressure and is removed as condensate at the bottom near the opposite end. Caustic flows through the tubes. Failures were occurring in the first 18 inches from the tube sheet where caustic enters and maximum condensation of steam occurs.

Sections of the tubes were submitted to Scovill and subjected to examination. Little scale or corrosion was found, on either surface, but the outside surfaces showed uniform thinning along their lengths. Wall thickness was reduced approximately .005" to .01".

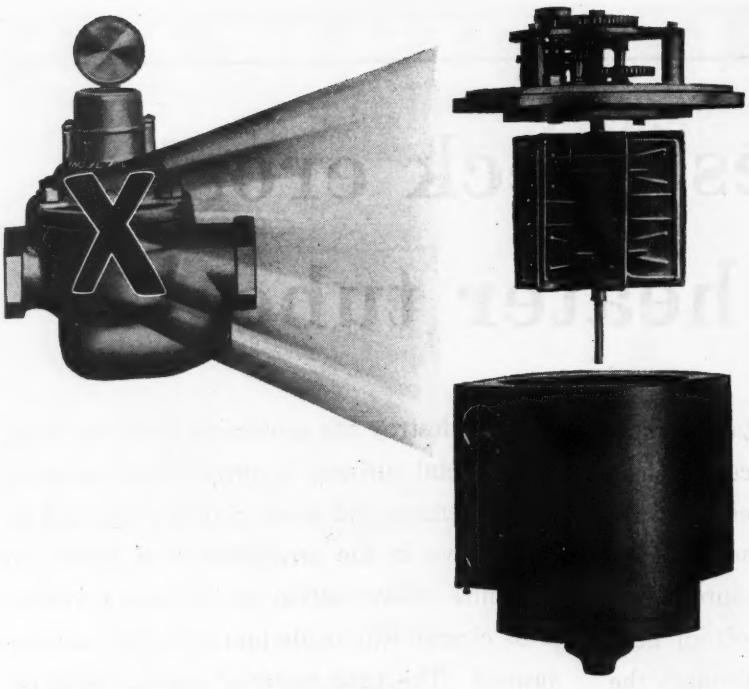
MISSING FILM LEADS TO CAUSE

Scovill traced this thinning of the walls to erosion, caused by impinging steam and condensate. This erosion was of sufficient magnitude to destroy the protective films, exposing clean metal surfaces to progressive corrosion by condensate and gases. Scovill suggested an alternative in the arrangement of baffles to minimize erosive action on the tube surfaces. This change was made and tube life was improved. The tube material has excellent resistance to corrosion by caustic and also to corrosion by steam and condensate, so no change in tube alloy was required.

OTHER SCOVILL SERVICES

In addition to *Service in Men* — consisting of consultation on tube problems and installation methods, Scovill offers two other services. *Service in Metals* covers the selection of alloys and study of specific problems in field and laboratory. *Service in Manuals* offers literature on condenser and heat exchanger tubes. For a copy of the booklet *Scovill Condenser Tubes*, address Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Connecticut.

CONDENSER TUBES
ONE PRODUCT . . . THREE SERVICES
Service in Manuals . . . Service in Metals . . . Service in Men



(X) *Marks the* **SPOT** *where the*

HENSZEY FEED WATER METER

gets its **ACCURACY** *and* **DEPENDABILITY**

Notice the simplified, rugged construction of the inside mechanism of the Henszey Meter. The rotor (directly connected to the gear train) fits into the measuring chamber without close clearances. Bearing surfaces, shafts and bushings subject to friction and hard wear are made of tough, long-wearing Stellite. Calibrations of the straight-reading horizontal register can be made to read in gallons, pounds, or cubic feet at any specified temperature.

Yes, that's why Henszey Meters are used for dependable, accurate measurement of boiler feed water, boiler blowdown, condensate, chemicals and other similar liquids. What's your hard-to-measure problem? Write today for a practical answer from Henszey.

HENSZEY CO. DEPT. C 5, WATERTOWN, WIS.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves

the manufacturer for use in chemical plants, hospitals, and research laboratories.

The new motor is rated ¼ hp at 600 rpm to 20 hp at 3600 rpm, 110, 208, 220/440, 550 v, 60, 50, 25 cycles. The construction is essentially the same as the Class I, Group D motors, but a special flamepath is used at the shaft openings to cool the flame of internal explosions. Thermostats operate in conjunction with a magnetic controller to disconnect the motor at a predetermined temperature, but do not supplant regular overload relays.

Other features of this motor include a cast-iron stator, a four-position cast-iron conduit box, and strong end shields of high-grade, corrosion-resistant cast iron with reinforcing cooling ribs. Effective cooling is provided by a nonsparking fan, and a convenient pressure-relief system provides for ease of lubrication without disassembly of the motor.

Supercharging of Gas Engine

A NEW ENGINEERING development which makes possible for the first time the supercharging of a gas engine and permits the instantaneous conversion from the use of either oil or gas fuel has been announced by the engineering department of The Cooper-Bessemer Corp., Mount Vernon, Ohio, through Ralph L. Boyer, chief engineer.

The new development will accomplish the following outstanding improvements:

1. In the oil field, it will make possible the use of supercharged engine of the Gas-Diesel principle in the drilling of deeper wells which predominate today.
2. In oil and gas pipelines, in addition to affording greater economy in operation, either gas or oil could be used for engine operation, depending upon availability of the supply and relative costs.
3. In oil field central pumping plants, it should be an important factor in increasing the economy and movability of these plants which are moved from one point to another as they complete their operations.
4. Stationary power plants will profit from the new development through concentrating the greater horsepower of the supercharged engine into less space than was necessary heretofore. This materially reduces the building and foundation costs.

In tests conducted by Cooper-Bessemer engineers on the company's LS-8 cylinder Gas-Diesel engine, which had an ordinary rating of 1100 hp, this engine was successfully supercharged up to a rating of 1600 hp at 327 rpm.

When this engine was changed over to gas, which was done on full load, the engine exhaust temperatures were decreased and the turbo-charger speed was also lowered. The reason for the lower exhaust temperature is unquestionably better combustion on gas than is obtained on oil. The lower turbine speed is the result of better combustion, but proves beyond question that the scavenging was with pure air and not with gas, since if any gas was blown through, it would burn in the exhaust manifold, thereby

CHOICE

MIDWEST "STANDARD" BUTT-WELDING ELBOW

MIDWEST "LONG TANGENT" BUTT-WELDING ELBOW

. . . . and ONLY MIDWEST offers THIS CHOICE

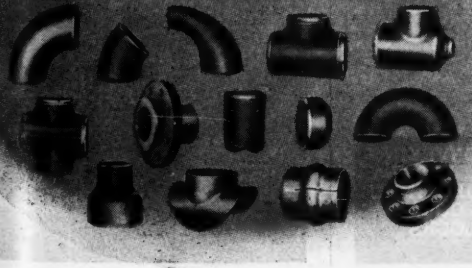
efore you select welding elbows to use on any given piping job, it will be worth your while to consider the relative values of the two elbows shown. On some jobs the correct selection can mean a real saving of time and money. Only Midwest offers you the choice of either type elbow . . . and there is no difference in price.

The "American Standard" elbow has a center-to-end dimension equal to one and one-half times the nominal pipe size. The Midwest "Long Tangent" elbow has a center-to-end dimension of one and three-quarters times the nominal pipe size; it has tangents (straight ends) equal to one-fourth of the nominal pipe size.

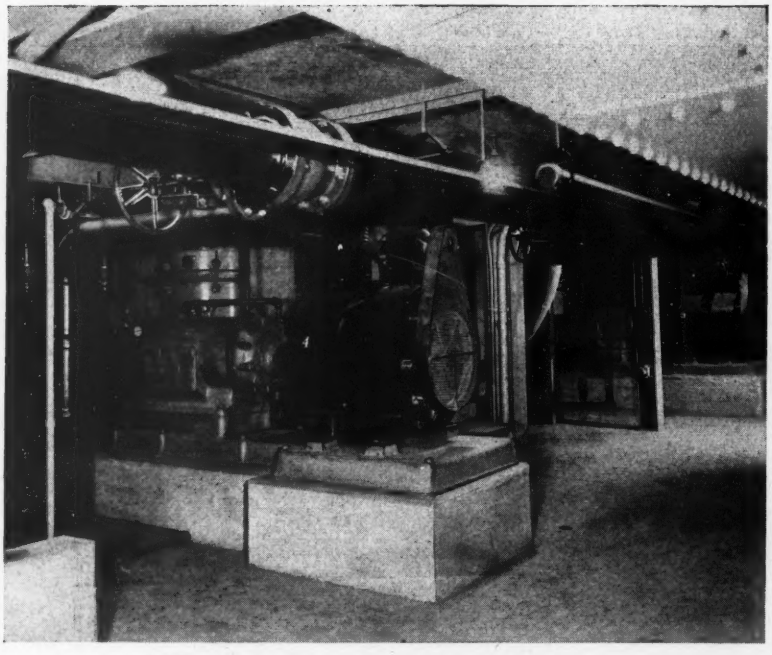
These long tangents make it possible for pipe and fitting to be lined up more quickly and accurately. Less pipe is required, a short nipple and an extra circumferential weld are frequently eliminated, and slip-on welding flanges are more easily used.

Both elbows have all advantages of the unique Midwest manufacturing process: final working of the metal in compression (which means exceptional dimensional accuracy and uniformity), stress relieving, exact included angle, true circular section and uniform wall thickness.

MIDWEST
WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



MIDWEST
PIPING & SUPPLY COMPANY, INC.
Main Office: 1450 South Second St., St. Louis 4, Mo.
Sales Offices: New York—(Eastern Division) 30 Church Street
Chicago—645 Marquette Bldg. • Los Angeles—520 Anderson Street
Houston—229 Shell Bldg. • Tulsa—533 Maya Bldg. • South Boston—
426 First St. • Atlanta—Red Rock Bldg. • Distributors in Many Cities



"Spotting"
Fuller Rotary Compressors
Air . . . Where and When Needed

The trend toward Fuller Rotary Compressors is becoming increasingly greater. Plant engineers and operators are constantly finding more and more places where installation of these machines proves of decided advantage.

"Spotting" compressors has many advantages. Machines operate only at pressures demanded by the work to be done. When a department has completed its daily cycle of operation, the compressor is shut down. This means a saving in power, supervision and maintenance. In addition, it also eliminates unnecessarily long transmission lines and consequent loss of power to compensate for pressure losses.

Photograph above shows two of a total of fourteen Fuller Rotary Compressors installed in one plant . . . "spotted" as close as possible to the point of utilization of the air.

You, too, can profit by such installations. Consult our engineering department. They'll be glad to work with you.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA
Chicago 3 · 1144 Marquette Bldg.
San Francisco 4 · 421 Chancery Bldg.
Washington 5, D. C. · 618 Colorado Bldg.

C-103

FULLER-KINYON . FULLER-FLUXO . THE AIRVEYOR CONVEYING SYSTEMS . . . ROTARY FEEDERS AND DISCHARGE GATES . . . ROTARY AIR COMPRESSORS AND VACUUM PUMPS . . . AIR-QUENCHING INCLINED-GRATE COOLERS . . . DRY PULVERIZED-MATERIAL COOLERS . . . MATERIAL-LEVEL INDICATORS . . . FULLER AERATION BLOCKS . . . SLURRY VALVES . . . SAMPLERS

increasing the turbine speed uselessly. The engine readily carried a 10 per cent overload on gas.

Flange for Metal Hose

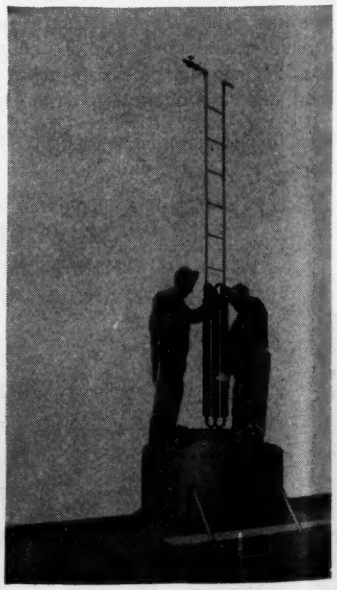
PACKLESS METAL PRODUCTS CORP., New Rochelle, N. Y., has developed a new detachable flange for helical flexible metal hose, in sizes 2, 2½ and 3-in. I. D. It is so designed as to permit repeated re-use. The assembly

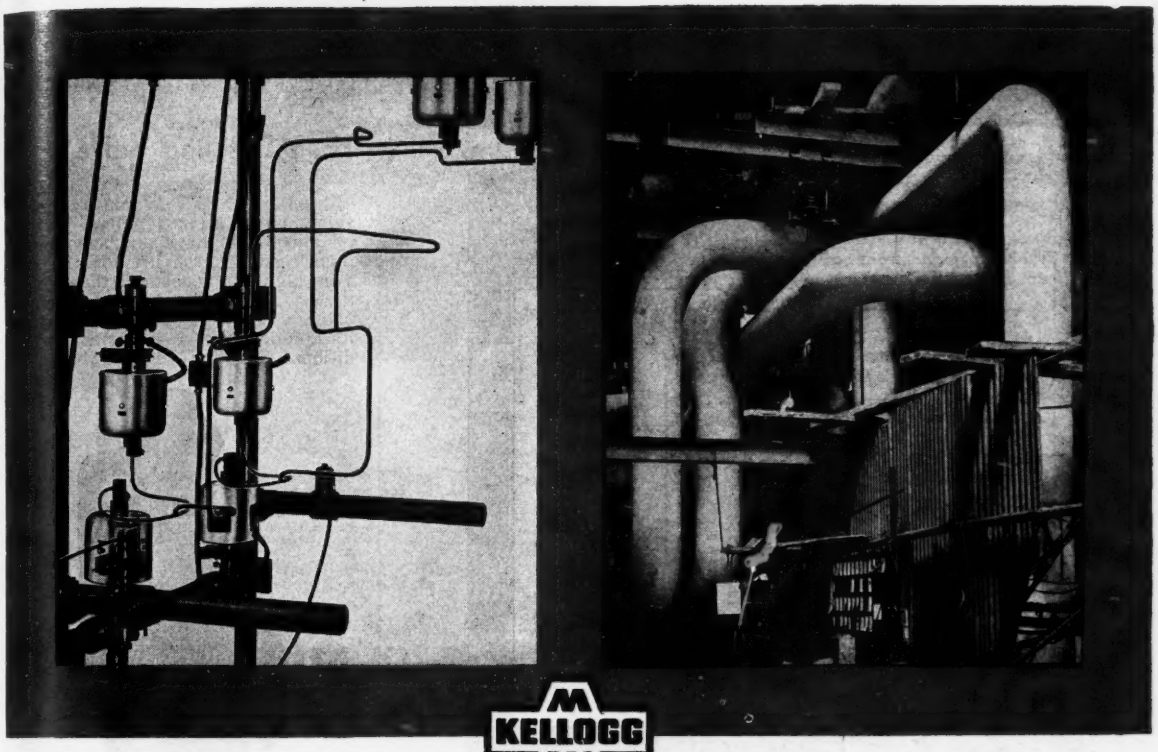
operation requires only ordinary shop tools, no brazing, and no gasket is employed to connect the flange to the hose, thus making a metal-to-metal seal.

Immersion Type Steam Tank Heater

Newly introduced by THE BROWN FINTUBE CO., Elyria, Ohio, this immersion type steam tank heater is used with any material the viscosity of which can be lowered by heating. The heaters speed up the emptying of tank cars and permit many viscous materials to be handled in cars not fitted with steam coils.

As illustrated herewith, the heater consists of a number of lengths of Brown Fintubes connected in series, and inlet and outlet steam lines. The heaters have low center gravity. Cross





KELLOGG

PIPING PROBLEMS
are Solved in Advance in the
KELLOGG LABORATORIES

Extremely accurate stress analysis of scale models, using electrical strain gauges, measuring load deflections to one millionth of an inch, enables Kellogg to furnish piping systems with complete assurance that they will perform as required when the plant is put in operation.

The "bugs" are thus found and eliminated even before the final drawings are allowed to go to the shop. This *design research* explains the acknowledged superiority of KELLOGG pipe installations. This is an exclusive Kellogg service available to consulting, power, process and marine engineers.

KELLOGG

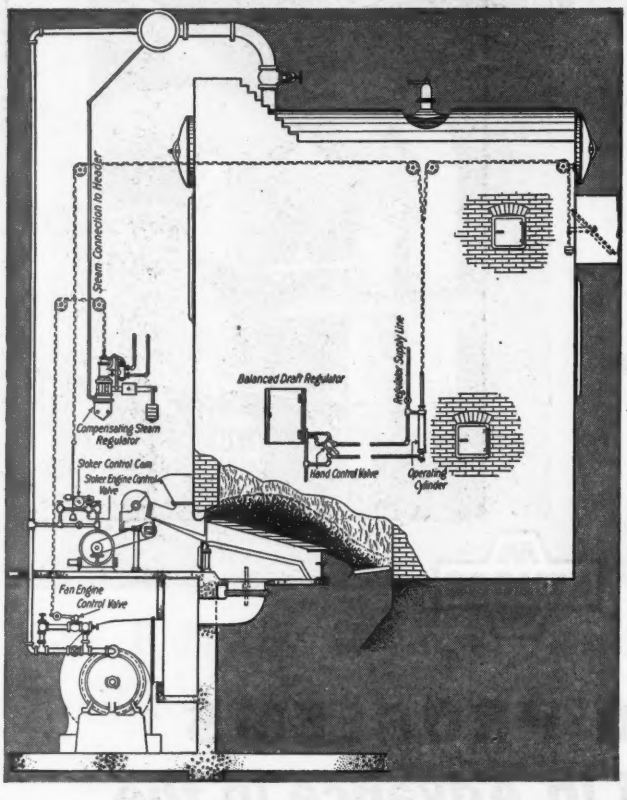
"Masterflex" Prefabricated Piping Systems · **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND · HOUSTON 2, TEXAS: 402 ESPERSON BLDG · TULSA: PHILTOWER BLDG

Enco Balanced Draft



A PRACTICAL SYSTEM THAT AUTOMATICALLY CONTROLS

. . . FURNACE PRESSURE, STEAM PRESSURE, FANS AND STOKERS

You can get all the advantages of balanced draft with the Enco system which conforms to accepted practices of combustion control and yet is simple and easy to install and maintain.

It is adaptable to all methods of coal firing . . . stokers of the underfeed, overfeed, spreader or traveling grate types, as well as hand-firing.

The apparatus is so free of complications and delicate mechanisms that it can be installed by your own maintenance crew and kept in operation with the greatest ease.

It may be either hydraulically or pneumatically actuated.

Ask for bulletin B.D. 43 on "Combustion Control" and get the facts on this practical, low cost system that has been in use for over 25 years on more than 1000 boilers.

THE ENGINEER COMPANY
75 WEST STREET Enco NEW YORK, N.Y.

handles aid in positioning the heater over the discharge outlet in the car, in blocking the heater at various depths, and removing the unit after the car is empty.

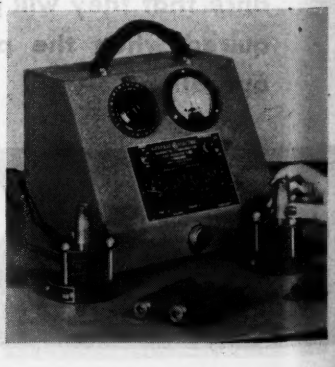
High Lift Pop Valve

FARRIS ENGINEERING CO., of Palisades Park, N. J., announces the development of a pop relief valve which is reported to have an exceptionally high coefficient of lift for the disc. This high lift is secured through the design of the valve disc, by which the velocity of the fluid is entrapped and its kinetic force is converted into additional lift for higher relief discharge. The new Farris pop valves, designed for pressures up to 300 psi are already in extensive use on steam, air, gas, water and other liquid process lines. They are made in sizes ½ to 2½ in. and meet full ASME specifications.

This valve is built with an adjustable single blow-down ring which permits regulation of the amount of pressure to be relieved on individual operations. Economical, minimum blow-down results.

Magnetic Comparator

GENERAL ELECTRIC CO., Schenectady, N. Y., has redesigned its magnetic comparator, which provides a quick, simple, non-destructive method of inspecting ferrous parts for quality control, so as to permit a more functional arrangement of its components. Desirable for testing rods, bolts,



Dearborn Engineer does this for you . . .

1 Studies your water and plant operating conditions.
2 Sends samples of your water to main laboratory for analysis.
3 Recommends proper chemical treatment and chemical control methods.
4 Supervises installation of feeding equipment.
5 Instructs your men on water test methods for treatment dosage adjustment and blowdown control.
6 Calls regularly to insure maintenance of recommended conditions.

The Dearborn Engineer in your vicinity is a versatile individual. He knows local water characteristics . . . he has a wide knowledge of plant operating conditions.

When you call him in to investigate troublesome boiler water, he gets to work . . . right in the boiler room. Takes a sample from the feedwater supply, gives it an "on the spot" test, and makes initial corrective recommendations to carry over the emergency.

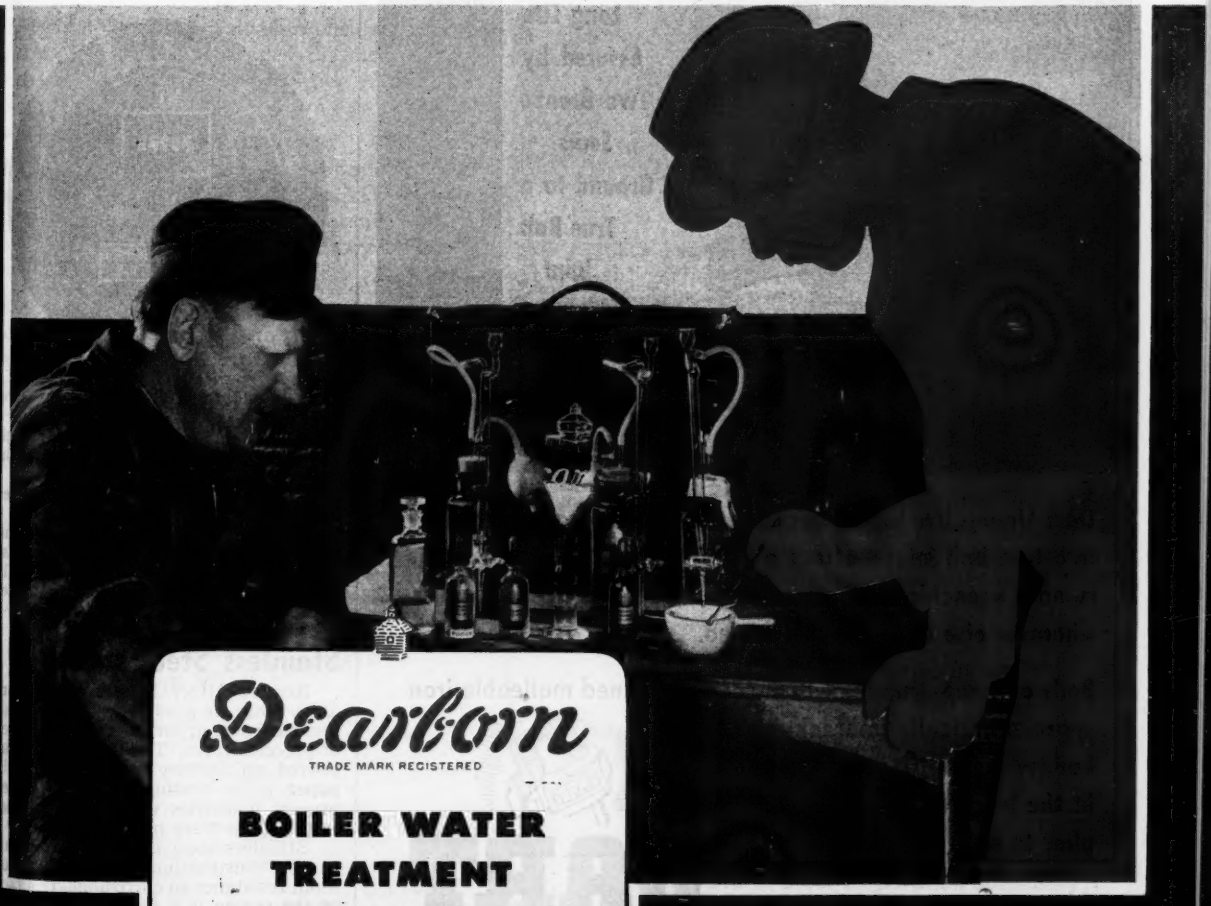
Then water samples are forwarded to the Dearborn laboratories where further analysis is made, and scientific counteracting treatment is prepared to neutralize the harmful tendencies.

Your local Dearborn Service Engineer then goes back in your boiler room to inaugurate the corrective measures, make periodic check-ups, and work with your men to keep boilers in full steaming capacity. Call him. He will serve you promptly and well.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave.
Chicago 4, Illinois

Dearborn Engineer serves you...

WITH HIS HANDS AS WELL AS HIS HEAD



Dearborn
TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

DARTS

ARE LONG-LIVED

Dart Unions live longer because their two bronze seats meet in a true ball joint—effect a leak-proof connection without ruinous wrenching. They may be uncoupled instantly for use wherever else they may be needed.

Body and nut—made of high-test air-refined malleable iron —are practically unbreakable. Longer lasting, Darts cost less in the long run. Tell your supplier to send you Darts.

DART UNIONS LIVE LONGER

DART UNIONS

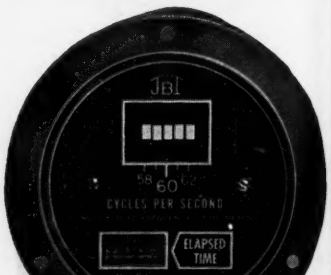
E. M. DART MFG. CO., PROVIDENCE 5, R. I.

springs, and small fabricated parts, this portable equipment immediately discerns variations in composition, hardness, or other characteristics which affect magnetic properties.

Features of the redesigned comparator include an attractive new grey steel case with a sloping front panel on which are located the indicating instrument, variable-voltage transformer, and the necessary rheostats and switches. Graduated dial plates on the sensitivity and balance control rheostats have been added to allow duplication of settings. In addition, a light now indicates whether or not the power is on. Receptacles for making connections to text fixtures and power source are now located at the back of the case, thus keeping wires out of the operator's way and allowing a clear view of the indicating instrument.

Frequency and Time Meter

J-B-T INSTRUMENTS, INC., of New Haven, Conn., has announced the development of a new electrical indicating instrument combining frequency meter and elapsed time meter in one case. It is used on engine-driven generator sets and other equipment where proper operating speeds, lubricating and overhaul schedules



are important considerations. Frequency or speed is indicated by a bank of five reeds calibrated in single cycle steps from 58 to 62 cycles. The running time meter is driven by a synchronous motor, and indicated elapsed time in hours and tenths.

Designated as Model 31-FE, this meter operates on 110-v and is also available for 48 to 52 cycles and in half cycle steps for 59 to 61 cycles and 49 to 51 cycles.

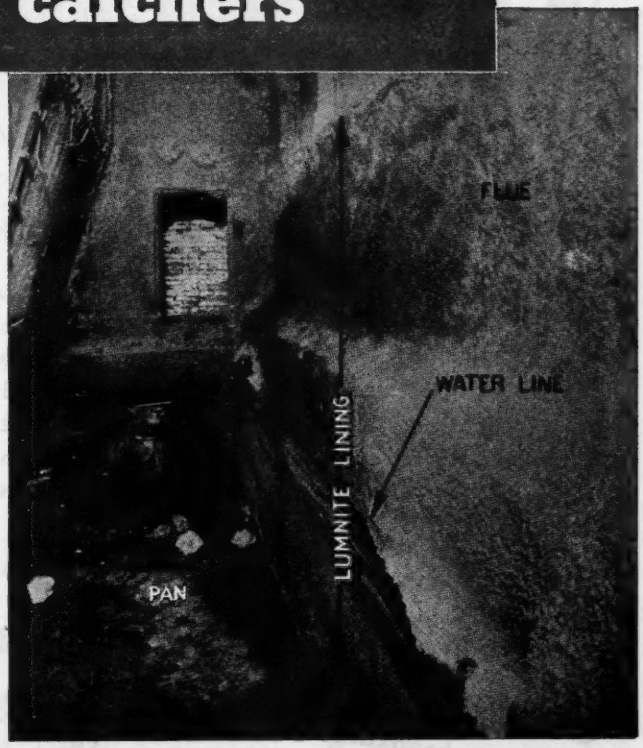
Stainless Steel Screen

RODNEY HUNT MACHINE CO., Orange, Mass., is producing a new stainless steel screen for use with all types of process water. The new screen has proved satisfactory in installations in paper mills, textile mills and other process industries where the original installations were made.

Stainless steel is used throughout in the construction to assure maximum resistance to corrosion. The face of the screen is a fine mesh stainless steel wire fabric which is backed up by a heavy gage screen of about 1-in. square mesh. Behind this backing

How to stop corrosion in cinder catchers

Concrete Linings made with LUMNITE outlast metal . . . sharply reduce maintenance repairs and costs.



The corrosion and deterioration of "wet type" cinder catchers caused a large power plant plenty of trouble and expense.

THIS WAS THE SITUATION at one of its stations: The water in the pan absorbed sulphur gases from the passing flue gas and soon contained quantities of sulphurous and sulphuric acids and sulphates. This mixture corroded the metal walls of the cinder catchers. Deterioration of the steel was hastened by abrasive effect of gas-borne fly ash and cinders.

HERE IS WHAT HAPPENED: Steel plates became slotted, cracks developed in welded joints, and corrosion left plates pitted and thin. Replacement of a section of the end wall was necessary at intervals of from three to six months.

THE SOLUTION—CORROSION-RESISTANT CONCRETE LININGS: Since no metal lining was found to resist deterioration tests were run on concrete made with different cements and aggregates. A lining of Corrosion-Resistant Concrete made with LUMNITE was shot over steel reinforcing mesh. This 2½-inch lining was placed on side walls and on the flue above the pan.

The dense lining of LUMNITE Concrete showed only hairline cracks after a year's service. It was unaffected at the water line. There was no abrasive effect because corrosion had not weakened and softened the concrete.

THE RESULTS: All 26 cinder catchers at this station today have LUMNITE concrete linings. Maintenance repairs have practically been eliminated, with a resultant saving of thousands of dollars. Reduction of time for repairs has increased station efficiency.

LUMNITE has other important power plant uses. It protects ash hoppers and coal bunkers from corrosion. It provides insulating abrasion-resistant linings for flues and stacks. For more information on LUMNITE in power plants, write:

FOR BOILERS AND FURNACES USE CASTABLE REFRACTORIES MADE WITH LUMNITE

● Castable refractories are factory-prepared mixtures of LUMNITE and selected aggregates. Packed dry, they are mixed with water on the job and cast into place for door linings, arches, baffles or furnace walls. Special shapes can be cast in simple molds and are ready for use within 24 hours.

Castables to meet different temperature and insulation needs are made by refractory manufacturers and sold by their distributors.

Specify Castable Refractories made with LUMNITE.

THE ATLAS LUMNITE CEMENT COMPANY

(United States Steel Corporation Subsidiary)

135 East 42nd Street, New York 17, N. Y.

CLEAR
REDUCES DANGER OF Blinded Eyes
The eyesight of your boiler room operator is too valuable to be endangered by shattering of ordinary gauge glass under today's heavy load conditions . . . Fit all water columns with SONDERGLASS, which thousands of engineers know as "The unbreakable gauge glass" because *its double-layer construction* resists high pressure strains . . . Comes in two popular types, Clear and Reflecting. Order from your dealer or directly from us.
SONDERGLASS
"The unbreakable gauge glass"
REFLECTING
A. W. CHESTERTON CO.
64 INDIA ST. • BOSTON, MASS.
DISTRIBUTORS IN PRINCIPAL CITIES

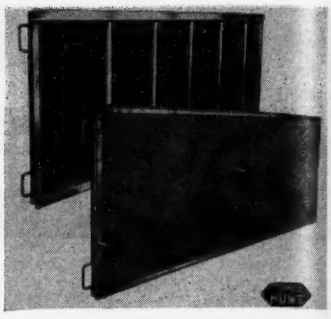
"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO



are the horizontal back struts of the frame itself, thereby providing maximum resistance to bellying and buckling of the fine strainer under water pressure.

The unit is light in weight and easily removed for quick cleaning. It is available in any dimension desired and can also be supplied with specially designed frames and quick acting hoisting apparatus for removing frames for cleaning, especially in larger sizes where removal becomes a problem.

Portable Pumping Unit

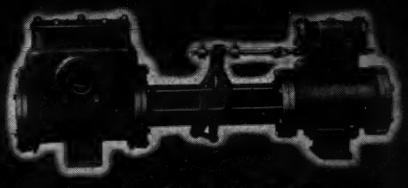
TO MEET THE requirements of plants where temporary pumping facilities are needed, Blackmer Pump Co., Grand Rapids 9, Mich., has developed a self-contained rotary pumping unit powered by a Wisconsin gasoline engine.

The unit illustrated consists of a 90 gpm bronze fitted standard Blackmer pump with built-in chatter proof relief valve, oil immersed drive and 2 hp gasoline engine, all mounted on a fabricated steel base which is fitted with telescopic handles for convenience in moving. The complete unit weighs 330 lb and is easily carried by two men.

Portable Insulation Tester

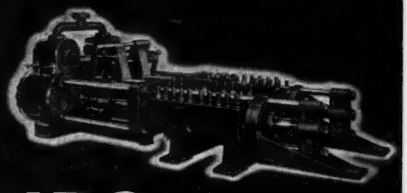
GENERAL ELECTRIC Co., Schenectady, N. Y., has announced a small portable insulation tester that can be carried in one hand, plugged into any 115-v, 60-cycle outlet, and is capable of supplying smooth variable test voltages from 0 to 2500 v. The set has a capacity of 750 volt-amperes and will stand one-minute loads of 1500 volt-amperes without injury. It can be used to test electric apparatus

Warren Two-Stage Volute Centrifugal Pump



Warren Steam Heat Vacuum Pump

Warren Horizontal Duplex Hydraulic Pump



WARREN PUMPS

for Post-War Planning Include:

Warren Type "L" Single-Stage Single-Suction Liquor Pump

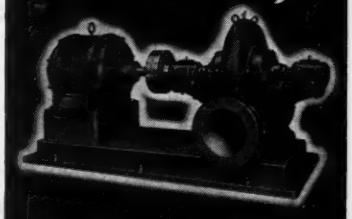
CENTRIFUGAL

Single and multi-stage
Pressure range: 0 to 850 P. S. I.
Capacities: 0 to 36,000 G. P. M.
Types: Horizontal & Vertical
Impellers: Open or enclosed
Casings: Horizontal or Vertical Split, cast iron or bronze
Bearings: Sleeve or ball-bearing

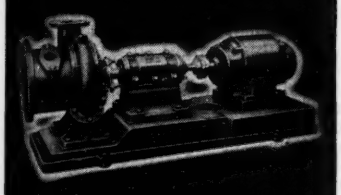
RECIPROCATING

Horizontal and Vertical single piston
Horizontal and Vertical duplex piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.

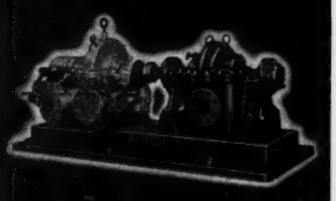
Send your pumping problem to us; our Engineers will recommend the right pump for the job.



Warren 14-in. Single-Stage Double Suction Pump



Warren Heavy Liquid Centrifugal Pump



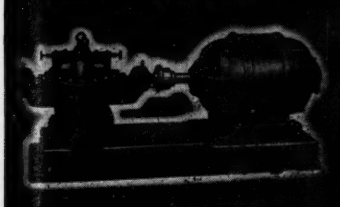
Warren Two-Stage Volute Centrifugal Pump

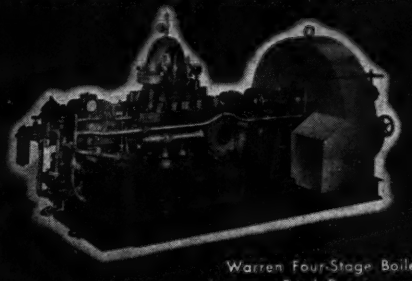
ARMY E NAVY

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

Warren Single-Stage High Speed Centrifugal Pump





Warren Four-Stage Boiler Feed Pump

Warren Horizontal "Realwear" Duplex Piston Pump

KEEP YOUR FINGER on the Pulse . . . WITH THE RICHARDSON AUTOMATIC COAL SCALE

Installation of portable Richardson Coal Scale weighing and delivering coal to stoker hoppers.

In a sense, coal consumption, as indicated by Richardson Scales, is the "pulse" of your power plant. Richardson Scales give you minute-to-minute records of coal consumed per boiler, per hour, per shift, week or year; records that point out a "coal-wasting" boiler or other operating inefficiencies. With this automatic and dependable coal weighing and feeding equipment, you can maintain your plant with minimum fuel consumption and maximum power output.

The Richardson COMPLETE SYSTEM for weighing, conveying and feeding coal from bunker to boiler is applicable to pulverizer or stoker-fired operation. On stoker installations, the Richardson "Monorate" Distributor removes the cause of segregating coarse and fine lumps of coal, and maintains a uniform velocity throughout, thus obtaining even distribution of coal across the stoker hopper.

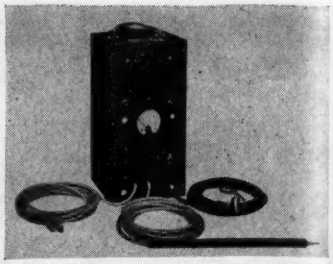
Richardson Coal Scales are available in the portable style as illustrated, for stationary support at mid-section, or at the floor line. Bulletin No. 1143, containing full details of all models, is yours for the asking.

7471

RICHARDSON SCALE CO.

CLIFTON, N. J.

Atlanta • Boston • Chicago • Omaha • Montreal • New York • Philadelphia
Minneapolis • Detroit • San Francisco • Toronto • Wichita • Pittsburgh



ranging from the wiring for small appliances to Diesel-electric locomotives up to 600-hp.

The complete set, compactly built into a small steel case, consists of a dry-type, step-up transformer, variable auto-transformer for smooth voltage control, indicating voltmeter, air circuit breaker with instantaneous overload trip, and control switches. Two 15-ft shielded test cables, one with an insulated test handle and the other with a spring clip for grounding one side of the high-voltage circuit, and a 15 ft supply cord with a connecting plug and ground clip, are also provided. The entire unit weighs only 47 lb, including the crackle-black enameled case measuring 15 by 7¾ by 8¾ in.

Electronic Motor Control

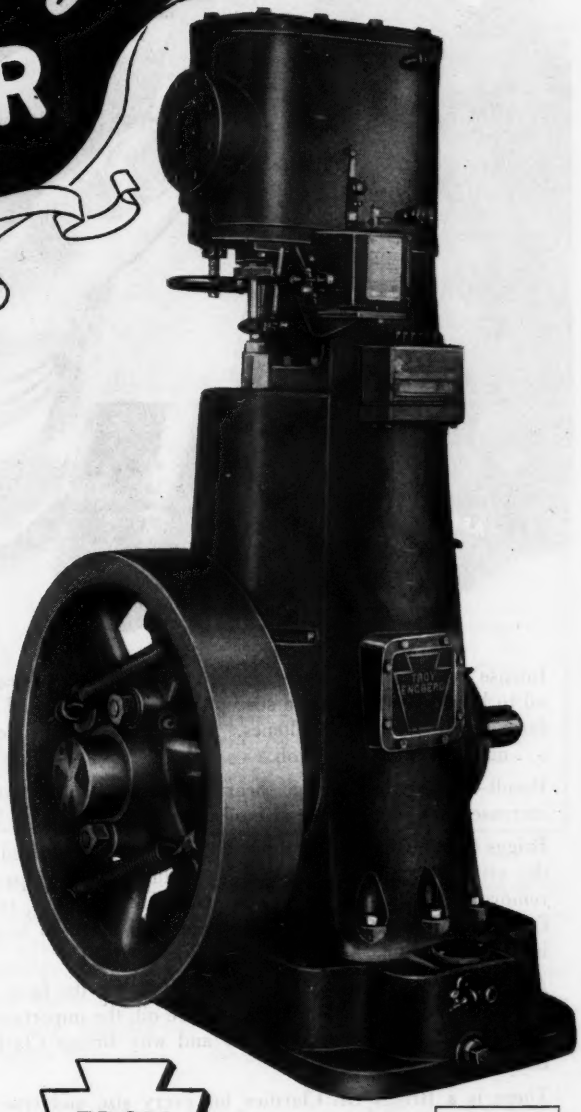
ELECTRON EQUIPMENT CORP., 917 Meridian Avenue, South Pasadena, Calif., has developed a new electronic motor control, the unit illustrated being a 25 hp model, for driving a dc motor from a 3 phase ac line and obtaining a wide stepless speed adjustment directly from the motor shaft.

In addition to the advantage of stepless speed control, the new unit is compensated for IR drop in the motor armature and will maintain practically straight line regulation over wide changes in load.

It also includes reversing, dynamic braking, controlled and adjustable acceleration, inching forward or reverse, preset speed, automatically timed tube heating, overload, undervoltage, field failure, and has the added advantage of being available in any size up to 500 hp.

The units may be operated in place of stationary motor-generators, or may be made portable, or used on board ship, as they will operate in

USE Steam Engine POWER



★ **FOR ECONOMY**

★ **FOR FLEXIBILITY**

★ **FOR DEPENDABILITY**

Troy-Engberg Steam Engines are the most economical drive obtainable when plant heat balances are right, as they are in many plants. In these cases, generally power costs are so low as to completely pay off all investment and installation costs in a few months or a year or two.

That Troy-Engberg Engines are flexible is evidenced by the fact that many companies, including utilities, have installed them for driving stokers on boilers operating under widely fluctuating loads.

As for dependability, we refer you to oil refineries where many Troy-Engberg Steam Engines are driving those important charging and transfer pumps. Dependability is the first requirement.

The modern reciprocating Troy-Engberg Steam Engine has so much to offer that its use should be considered for every drive in your plant. Single engines range up to 225 hp, vertical or horizontal; duplex, up to 450 hp.

TROY ENGBERG

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

TROY ENGINE & MACHINE CO.

Established 1870

875 RAILROAD AVENUE **TROY, PENNSYLVANIA**

5-TEM-3

Intense heat, high pressures, violent agitation cause weaker molecules in oil to break down—become susceptible to oxidation and polymerization—form gums, resins, asphaltenes. When this happens, oil becomes tired . . . unable to do its vital job.

Result—piston lacquering, bearing failures, premature engine wear, increased upkeep and excessive oil consumption.

Briggs Oil Clarifiers prevent the disastrous results of tired oil. They remove the visible contaminants in oil . . . dust, metal chips and grit. They remove the invisible products of oxidation . . . gums, resins, asphaltenes. Oil clarified in a Briggs Clarifier does a better job longer, maintenance is lowered, trouble is prevented.

Ask the Briggs Distributor in your locality for the facts about the advantages of continuous maintenance of lube oil, the importance of clean Diesel fuel oil. He will show you how and why Briggs Clarification goes far beyond ordinary filtration.

There is a Briggs Oil Clarifier for every size and type internal combustion engine . . . for every type of oil . . . for practically every purpose.

Consult Briggs FIRST on any filtration problem.

ARMY E NAVY

Briggs

PIONEERS IN MODERN OIL FILTRATION

BRIGGS CLARIFIER CO. **Washington 7, D. C.**

Representatives in Principal Cities—listed in the "Filter" section of most classified telephone directories

any position and without any foundation.

They will provide any direct current voltage from 0 to 270 v, or from 0 to 600 v according to type selected. Complete locked enclosures are provided with forced draft cooling.

Obituaries

A. V. de Forest

ALFRED VICTOR DE FOREST, member of the faculty of the department of mechanical engineering at Massachusetts Institute of Technology and president of the Magnaflux Corp., died at Marlboro, N. H., on April 5 at the age of 56 years. Professor de Forest developed the Magnaflux Test, a magnetic method for discovering defects in metals, and was the founder of the Magnaflux Corp.

From 1916 to 1928 he was associated with the Union Metallic Cartridge Co. as research engineer and during the following ten years was research engineer for the American Chain Co. In 1936 he received the Longstreth Medal of the Franklin Institute for inventions and improvements in machines and mechanical processes. In 1938, the Institute of Aeronautical Sciences awarded him the Sylvanus Albert Reed Award for development of a method used by the aircraft industry for testing metals magnetically; and in 1940 he received the Modern Pioneers Award for meritorious service to industries and mankind.

Professor de Forest was born in New York City and was graduated from MIT in 1912. He began his career with the drafting department of the New London Ship and Engine Co. and a year later became an instructor in engineering at Princeton University.

Arthur W. Patterson, Jr.

ARTHUR W. PATTERSON, JR., vice-president of the Engineer Co., 75 West Street, New York City, for the past 26 years, died at his home in Roselle, N. J., on March 5. He was 73 years old and is survived by his wife, two sons, Lieutenant A. W. Patterson and Richard K. Patterson of Columbus, Ohio.

Harry L. Delander

HARRY L. DELANDER, a long-time member of the Advertising Department of Crane Co., Chicago, died suddenly of a cerebral hemorrhage on Friday night, April 13. Mr. Delander completed 40 years of Crane service last December. He had filled almost every job in the department as changing conditions altered the company's advertising program. His latest interests were the editorship of Valve World and of the company's two internal house organs, one for salesmen and one for Crane men in military service.

Mr. Delander will be long remembered by industrial advertising men as one of the founders and the first president of the Engineering Advertisers Association in 1919, and an ac-

FOR TANK INTERIORS

Corrosion Protection that Has Been Proved at Sea

Here is a corrosion-resistant coating for interiors of all types of cold-water tanks, steel cooling towers and all metal surfaces exposed to water under 125°F.

APEXIOR NUMBER 3 has earned a world-wide reputation in the marine field, having the longest record of success in protecting marine stern plates and condensers against the combination of salt water and electrolytic action.

1,500,000 gallon radial-cone elevated water tank in Texas

This is what happened to a cold-water tank *before* it was APEXIORIZED. But APEXIOR has kept it from getting any worse for nine years. It's an area of a cylindrical open-top steel reserve storage tank, containing potable Boston city water for ice-making. All internal surfaces, some badly corroded, were cleaned and given two coats of APEXIOR NUMBER 3 in 1935. Photograph was made after seven years. No touching up or re-coating has been required since. The coating remains in good condition.

COMPOSITION: APEXIOR NUMBER 3 is a shiny-black paint, a combination of asphalts (100%) dissolved in a suitable solvent. The deposited film when free of solvent is non-toxic and suitable for the coating of tanks to contain potable water.

To prepare for APEXIOR, clean surfaces thoroughly to bare metal — sand-blast if possible — then apply two coats of APEXIOR NUMBER 3 by hand brush. An original abrasive blast cleaning (never again necessary) provides a permanent maintenance base upon which APEXIOR protection can be established. APEXIOR is shipped for use as received — no thinner permitted.

Here's economical insurance against rust for any cold-water handling equipment. Get additional details today. Use the coupon below.

APEXIOR

Keeps new metal new . . . Gives old metal new life

The **DAMPNEY COMPANY**
of America
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Massachusetts

Please send free Bulletin 1290.

Name.....

Company.....

Address.....

tive participant in the launching of the National Industrial Advertisers Association.

S. M. Birch

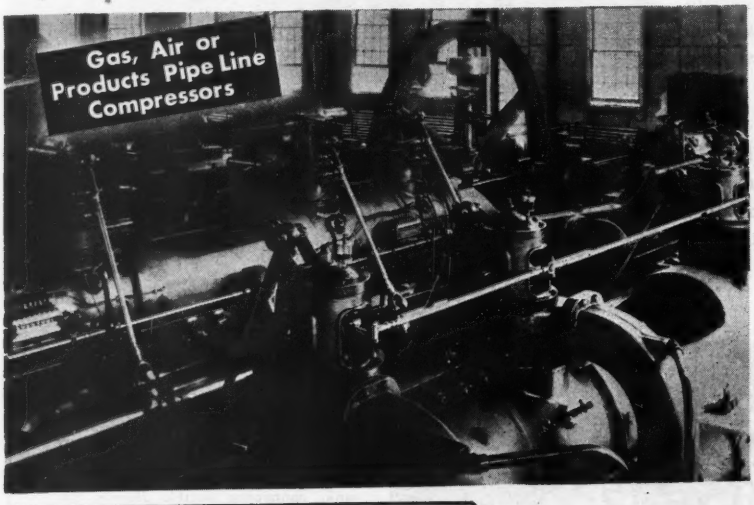
STEPHEN M. BIRCH, advertising manager of the Texas Company, died April 10 at the Post Graduate Hospital in New York City. He was fifty years old and lived at 145 East Fifty-fourth Street.

Mr. Birch was born in Robinson, Ill., and became a second lieutenant in the first world war, after attending the University of Illinois and the University of Pennsylvania. In 1919 he worked in the Chicago branch of Erwin Wasey & Co., advertising, and in 1921 he joined the Fairchild Publications Co. in Chicago. He then returned to Erwin Wasey, where he was assigned the account of the Indian Refining Co., now part of the Texas Co., and later joined the Texas Co. as advertising manager in 1938.

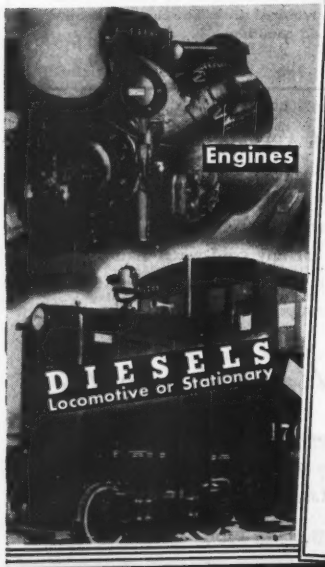
Frank C. Allen

FRANK BERRY ALLEN, of Flat Rock road, Narberth, head of Allen-Sherman-Hoff Co., of Philadelphia, Pa., and president of the Metropolitan Philadelphia Society for Crippled Children, died suddenly April 8 of a heart attack in Tampa, Fla. He was 57 years old.

Mr. Allen was a member of the Union League, the Engineers Club and Merion Golf Club. He was in Florida on a combined business and health trip when stricken.



WATER PROBLEMS RESPOND TO



HAERING GLUCOSATES

FOR

CORROSION & SCALE CONTROL.

—o—

WRITE FOR

"H-O-H WATER STUDIES"

WE READ WATER

D. W. HAERING & CO., Inc.

GENERAL OFFICES:

205 West Wacker Drive, Chicago 6, Ill.

MANUFACTURERS' News

The Lunkenheimer Co., Cincinnati, Ohio, on March 13 elected the following officers and directors Frank P. Rhame, President and General Manager; Homer E. Lunken, First Vice-President and Assistant General Manager; Harry A. Burdorf, Vice-President, Sales; Charles W. Burrage, Secretary; Chester C. Isekeit, Treasurer and Controller. Directors are Harry A. Burdorf, Henry G. Frost, Chester C. Iskeit, Carl M. Jacobs, Edmund P. Lunken, Homer E. Lunken, Frank P. Rhame.

The International Nickel Co., Inc., Development and Research Division, announces the formation of the following newly created sections of the Division called Industrial Chemicals Section to be headed by O. B. J. Fraser; Corrosion Engineering Section, with F. L. LaQue in charge; Iron and Non-Ferrous Casting Section, headed by Donald J. Reese.

At the annual meeting of the shareholders, approval of a change in name of The Eagle-Picher Lead Co. was voted. The company now is to be known as The Eagle-Picher Co. For many years Eagle-Picher has engaged in the manufacture and sale of numerous products that are not made of lead and the management felt that the use of this word in the title restricted the public concept of the scope of the company's activities. This change in name does not affect two wholly owned subsidiaries, The Eagle-Picher Mining & Smelting Co. and The Eagle-Picher Sales Co

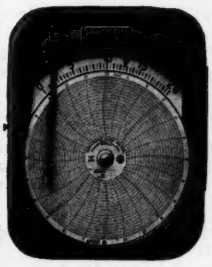
Foster Wheeler Corp. has recently elected John E. Kenney and E. R. Goodrich as vice-presidents of the corporation. Mr. Kenney has been director of the western offices with headquarters in Chicago since 1940 and Mr. Goodrich has been associated with the corporation since his graduation from Yale University in 1912.

The United States Rubber Co. states that 53 new synthetic rubbers were produced in the three synthetic rubber plants operated by the company during 1944. Of these new rubbers 8 types have been adopted for regular use in the manufacture of rubber insulation of electric wire and cable, porous rubber storage battery separators, asbestos sheet packing, and pressure sensitive adhesives. It is stated that during the past year 14 million pounds were made for these special purposes. Of the other 45 types many are being evaluated and it is expected that additional uses will develop.

Westinhouse Electric & Mfg. Co. has recently formed an Aviation Gas Turbine Division for the manufacture of military and commercial gas turbine aircraft engines, based on the jet engine already developed by this company for the Navy. Vice-President L. E. Osborne states that the new engine is expected to produce more propulsive thrust for its weight than any other aircraft engine built

THE MOST COMPLETE LINE OF FLOW MEASURING INSTRUMENTS

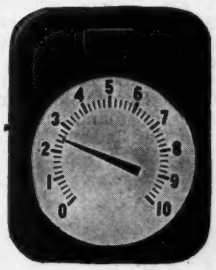
ARMY E NAVY



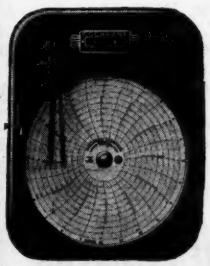
Electric Flow Meter
Null Balance Principle
Described in Publication 3010

Mechanical Flow Meter
High Torque—Tilting U-Tube
Described in Publication 3010

Boiler Ratio Meter
Steam Flow—Air Flow
Described in Publication 4071



Liquid Level Meter
Friction-Free
Described in Publication 3010



Temperature Recorders
Pressure Recorders
Described in Publication 3010

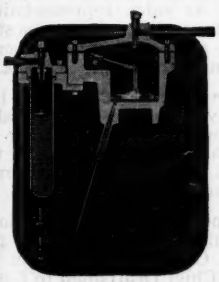
Described in Publication No. R-100A

Free Float Rotameters

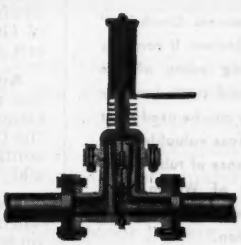
Described in Publication No. R-100A

Guided Float Rotameters

Ring Balance Meters
Described in Publication 3010



Stationary U-Tube Meter
Described in Publication 3010



Linameter—For Viscous Volatile Corrosive Fluids
Described in Publication 3010

Gas or Air Flow Recorders
For Low Static Pressure Gases
Described in Publication 3010

Weir Meter
To Measure Flow of Liquids over weirs of various shapes
Described in Publication 3010

COCHRANE CORPORATION • 3123 North 17th Street • PHILADELPHIA 32, PA.

COCHRANE

FOR 80 YEARS DESIGNERS AND MANUFACTURERS OF STEAM POWER PLANT EQUIPMENT

to date. It will power combat aircraft of the U. S. Navy.

George H. Woodard, formerly manager of the company's New Products Division at East Pittsburgh, Pa., will be the manager of the new manufacturing division which will have its headquarters at the Westinghouse South Philadelphia Works.

W. F. Boyle, who formerly co-ordinated gas turbine activities within the Steam Division has been named sales manager of the new division. Reinout P. Kroon has been named manager of the Engineering Department and Samuel S. Stine will be manager of manufacturing for the Aviation Gas Turbine Division.

Elliott Co., Jeannette, Pa., has elected W. A. Elliott, vice-president in charge of sales. Also, Ronald B. Smith, manager of engineering research and development, was elected vice-president in charge of engineering. M. G. Shevchik, secretary, was elected secretary and treasurer. Re-elected officers include: Grant B. Shipley, board chairman and president; F. H. Stohr, assistant to the president; R. W. Owens, vice-president in charge of manufacturing, and Dundas Peacock, controller.

Baldwin Southwark Division of the Baldwin Locomotive Works in conjunction with Westinghouse Electric & Mfg. Co., has developed a new method of molding rubber on a small high speed press which is said to effect a substantial reduction in curing time compared with conventional equipment. The new method is capable of molding all kinds of mechanical rubber goods, plumbers' supplies and other items where cavity-molding is needed. While this new method can be used without preheating of the material, a still further increase in production may be obtained by using electronic radio frequency heating where possible.

U. S. Industrial Chemicals, Inc., of New York City, has acquired the exclusive manufacturing and sales rights of the PiB Chemical Co., makers of PiB liquid insulation; a product extensively used as a protection against corrosion, a supplementary insulation and water-proofing agent for tractors, farm machinery and pumps, as well as internal combustion engines and electric motors.

Alfred Kauffmann, retired president of Link Belt Co., was elected a director of the Gardner-Denver Co. at the recent annual stockholders' meeting. Mr. Kauffmann succeeds P. H. Gardner, who has resigned his directorship, because of ill health.

Enterprise Engine & Foundry Co. of San Francisco, has elected the following men to the Board of Directors: G. J. Panario, W. L. Andrews, A. O. Stewart, W. E. Butts, C. P. Hoehn, C. S. Herbert and C. H. Schimpff. The organization of the Board of Directors is now: G. J. Panario, chairman; C. P. Hoehn, president; C. S. Herbert, executive vice president and secretary-treasurer; H. C. McKenna, controller and assistant secretary; and R. E. Kroeck, assistant secretary.

The solution of special and apparently difficult tube-cleaning problems is really easy with Wilson Tube Cleaners—in eight or nine cases out of ten, it can be done without designing new or unconventional motors, cutter-heads, cutters or accessories. A review of literally thousands of special tube-cleaning problems presented to Wilson engineers shows that 80% to 90% were satisfactorily solved by selecting the right combination of Wilson parts. In other words, a combination of one of the many Wilson motors and cutter-heads or brushes, plus accessories such as universal joints, shafting, etc.—solved the problem.

A copy of The "Tube Cleaners Check-List" will help you make this selection. It contains a selection guide, showing many of the standard Wilson motors and cutter-heads—with ideas as to when they can be used most efficiently. In addition, it gives valuable hints on operation and maintenance of tube cleaners—plus a handy table of Wilson Tube Cleaner sizes. Your copy will be sent on request and without obligation.

Modern tube-cleaners for the problems of today.

wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

MANUFACTURERS' *Personals*

Warren Steam Pump Co., Warren, Mass., has appointed C. E. Johnson & Associates, 401 Bona Allen Bldg., Atlanta, Ga., as sales representatives. Their territory will comprise the state of Georgia, eastern Tennessee, northern Alabama and eastern Florida.

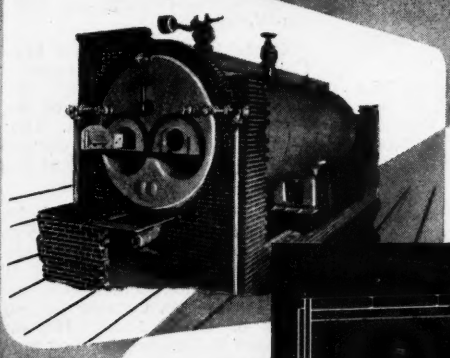
American Chain & Cable Co., Inc., has recently appointed E. J. Flood as General District Sales Manager for the Chicago Sales Territories. He will continue to make his headquarters at 400 W. Madison Street, Chicago, Ill.

The Cooper-Bessemer Corp., Mount Vernon, Ohio, has announced the promotion of C. M. Bovard from the position of Chief Draftsman to Design Engineer and the elevation of Ralph H. Schlosser to Chief Draftsman. Mr. Bovard has been with the corporation for the past 20 years and Mr. Schlosser has served in the company's drafting room for 31 years.

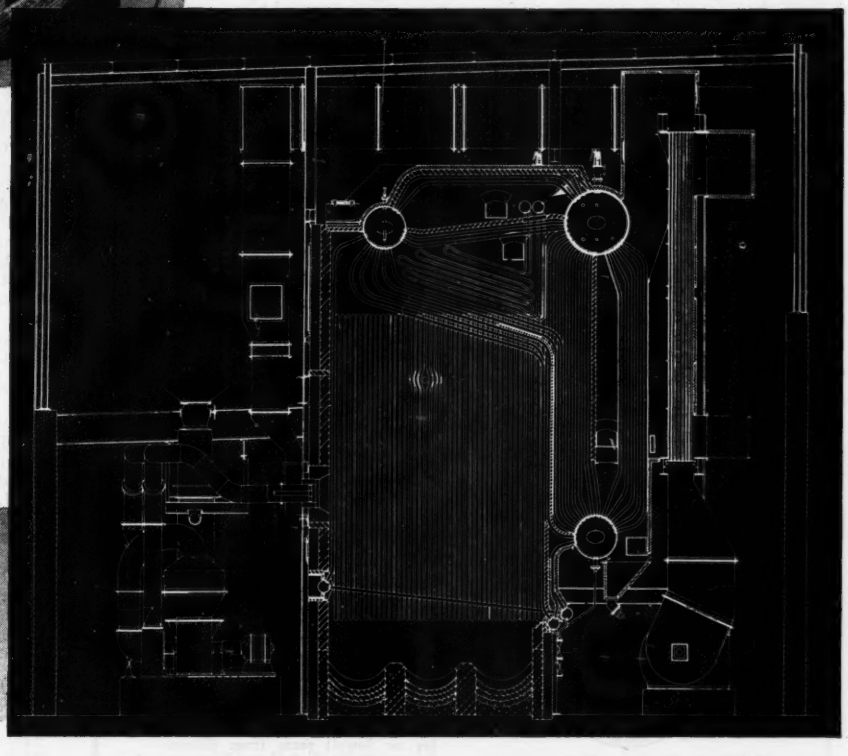
United States Rubber Co. has appointed Luther B. Martin director of tire development and research for the company with his headquarters at Detroit.

Baldwin Southwark Division of The Baldwin Locomotive Works announces the resignation of Frederick G. Schranz as vice-president, an office he has held since 1941. His retirement takes place on April 30. Mr. Schranz has been associated with

Edge Moor
water tube boilers—



The Edge Moor Improved Galloway Boiler of the 1880's. It was described as "an internally fired boiler with two furnaces, uniting into one common central flue, which flue contains numerous conical tubes that cross the flue in nearly vertical lines."



Edge Moor radiant heat unit arranged for pulverized coal or liquid fuel firing. Equipped with superheater and Edge Moor vertical tubular air preheater. Capacity 75,000 lbs. steam per hour; Drum Pressure 665 psi; Degrees of Superheat 210° F.; Final Steam Temperature 700° F.

Down through the years since 1878, Edge Moor has continued to contribute to the store of knowledge and experience gained in the building of steam generating equipment. Modern demands are for continuous service and high ratings with maximum operating efficiency. Edge Moor meets these demands through a combination of skillful design, carefully selected materials and unsurpassed workmanship.

Edge Moor boilers are built in all standard designs of any required capacity, for drum pressures up to 900 lbs., and adapted to all methods of firing both solid and liquid fuels. Auxiliaries include water cooled furnaces, superheaters, economizers, air preheaters and steam washers. Complete installation service is available.

Inquiry as to Edge Moor's recommendations for your particular requirements will be given careful study, and complete proposals will be promptly submitted.

STEAM GENERATING EQUIPMENT

EDGE MOOR

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE AND WORKS: EDGE MOOR, DELAWARE

Baldwin since 1915. Baldwin also announces the appointment of Robert G. Allen as General Manager of Baldwin Southwark Division. He has had many years of experience as an executive in industrial plants and more recently has seen service in the U. S. Army, having attained the rank of Lieutenant Colonel in February, 1943. He was placed on the inactive list in January, 1945.

Westinghouse Electric & Mfg. Co. has announced the following changes in personnel: Patrick W. Cross becomes manager of the Sao Paulo office of Westinghouse Co. in Brazil; W. W. Parker, becomes Regional Engineer in the Rio de Janeiro Office; Ellis L. Spray becomes vice-president of the company in charge of elevator and air conditioning activities with offices at Jersey City, N. J.; Ross Rathbun and Walker G. White will continue as managers of the air conditioning and elevator divisions.

The Ohio Injector Co., Wadsworth, Ohio, has appointed Joe W. Greene as general sales manager.

The Henszey Co., Watertown, Wis., announces that J. O. and C. U. Martin, 637 Minna Street, San Francisco 3, Calif., have been appointed Northern California agents for Henszey Boiler Plant specialties.

Climax Industries has announced that John H. Seippel, formerly General Manager of Hoffman Specialty Co., has joined Climax Industries as Vice-President. Mr. Seippel will make his headquarters in the Civic Opera Building, Chicago, Ill. The companies in the Climax Industries group include Climax Engineering Co., McAlear Manufacturing Co., and Hanlon-Waters.

General Electric Co. has appointed Carl A. Salmonsen manager of the company's Philadelphia Works and Robert Paxton manager of the G-E Pittsfield (Mass.) Works. The company also announces the early retirement of L. E. Underwood as manager at Pittsfield.

United States Steel Corp. has announced the following personnel changes: John J. Hefferman has been appointed purchasing agent of the Atlas Lumnite Cement Co. and the Universal Atlas Cement Co., subsidiaries of U. S. Steel. He succeeds Richard B. Hynes who died on March 21. Myron E. Capouch has been appointed assistant manager of the wire rope and construction materials division of American Steel & Wire Co., succeeding B. S. Pease who retired after 36 years service. Clarence E. Wynn has been promoted to manager of the industrial relations for Tubular Alloy Steel division plant in Gary, Indiana. He follows Gray D. Hobby who has been transferred to a corresponding position in the company's Lorain Works.

Corning Glass Works has announced the following appointments in the Technical Products and Bulb and Tubing Divisions of their company: Edward C. Leibig becomes assistant to the director of glass technology; Justin J. Pfeiffer has been advanced from manager of the company's Central Falls, Rhode Island, plant, to manager of manufacturing for the Technical Products Division; D. Kenneth Shaddock succeeds Mr. Pfeiffer as manager of the Central Falls plant being advanced from production superintendent of this plant.

The Briggs Clarifier Co. of Washington, D. C., has appointed Mack Sales, 425 East Platt Street, Tampa, Florida, as distributor for this state. Also LaGrave and Company, 812 1st National Bank Annex, Mobile, Alabama, to handle distribution of the company's products in central and southern Mississippi, in southern Alabama and in northwestern Florida.

American Engineering Company, Philadelphia, announces the appointment of three additional sales agents: Milton G. Brown, 1847 East 28th St., Minneapolis 7, Minn., representative in Minnesota, North Dakota, South Dakota, and northwestern section of Wisconsin. J. J. O'Shea, 305 Techwood Drive, N. W., Atlanta, Ga., representative in Alabama, Florida, Georgia and South Carolina. Thomas C. Messplay, 5916 McGee St., Kansas City, Mo., representative in the states of Kansas, Oklahoma and the western section of Missouri.

John L. Young has been elected to the newly-created position of vice-president in charge of engineering of the National Tube Co., a subsidiary of U. S. Steel Corp. Mr. Young has been vice-president of industrial research and development of the United Engineering & Foundry Co. in Pittsburgh.

RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal

Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

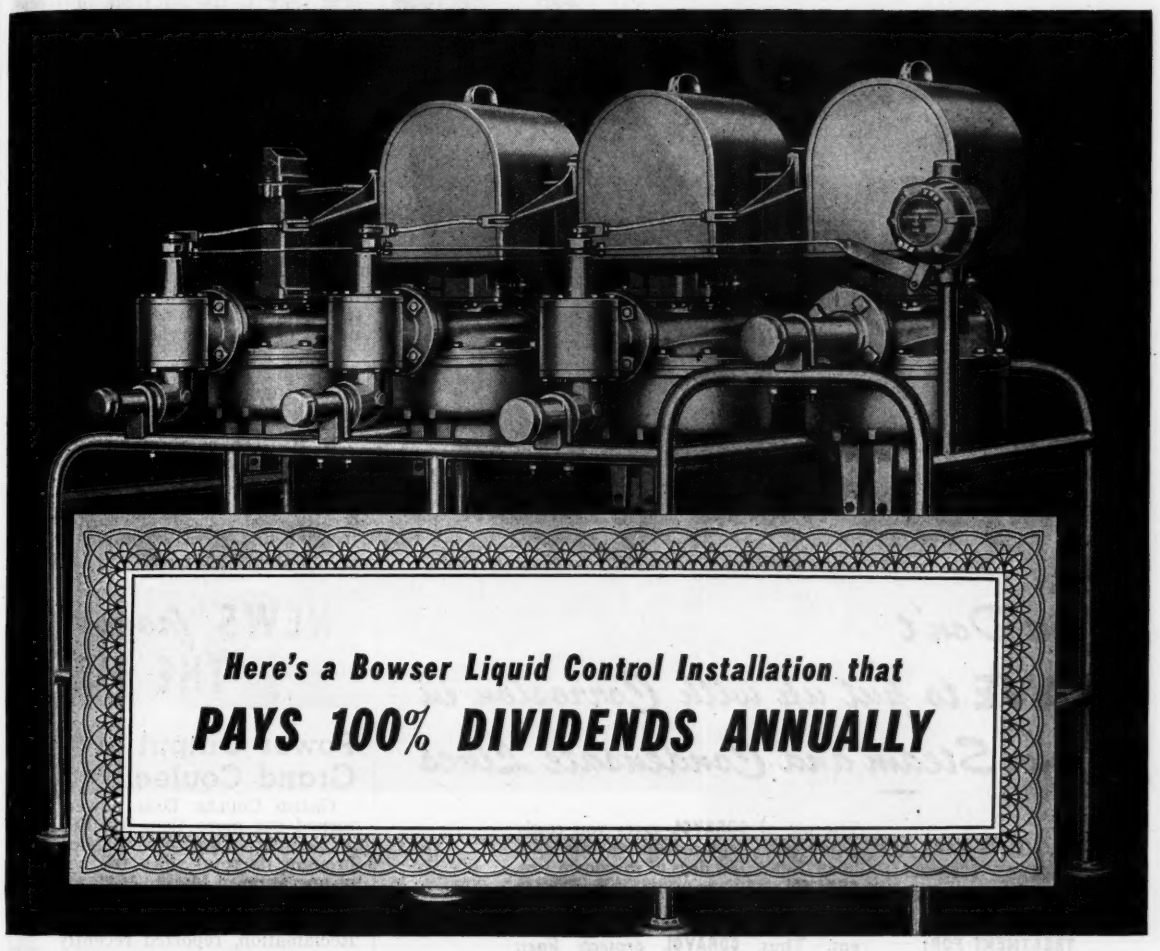
ANTHRACITE — Hazle Brook Premium
. . . Raven Run

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH



Here's a Bowser Liquid Control Installation that

PAYS 100% DIVIDENDS ANNUALLY

A nationally known plant in New York State installed a Bowser 2-meter Soluble Oil Proportioner for grinding and cutting solutions used in seven different departments. Previously the solutions were mixed in open drums and distributed manually.

RESULTS . . .

1. Three laborers, one for each shift, were released for other work. Estimated annual saving—$9,360.00.

2. Soluble oil consumption was reduced 10%. Estimated annual saving—$900.00.

3. Space for two storage drums was saved in each of seven departments. The proportioner and tanks in the oil house take only 30 square feet.

The first year's saving on labor and oil far more than paid for the entire installation. After that, it's "velvet."

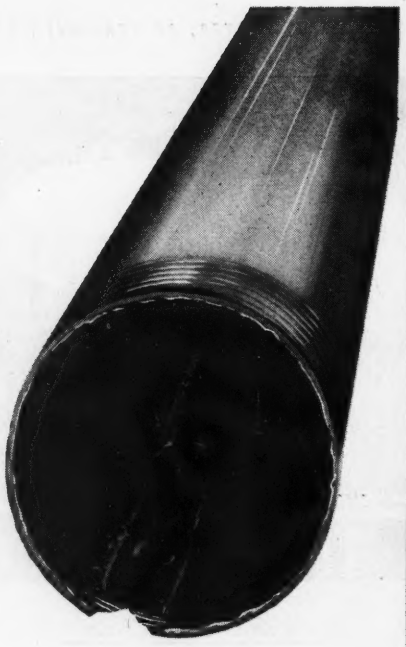
Virtually every plant has a positive need for *something* Bowser makes. In the power industry Bowser Liquid Control—turbine oil conditioners, filters, force feed lubricators, for instance, are doing a better job. Operating tests, conducted by impartial experts, have shown that oil, if kept perfectly clean, remains as good as new. Bowser Pressure Filters, working under severe power plant operating conditions have demonstrated their ability to keep oil clean much longer—thus prolonging equipment life and saving money. BOWSER, INC., Dept. 4-E, Fort Wayne 2, Ind.

BUY WAR BONDS

Not only has Bowser's war production earned the Army-Navy "E" . . . Bowser equipment has helped earn it for scores of other companies.

BOWSER ESTABLISHED 1885

The Name That Means Exact Control *of Liquids*



You Don't
HAVE *to put up with Corrosion in Your Steam and Condensate Lines*

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE WHICH PROVIDES SPECIAL FORMULAS OF TREATMENT FOR:

Boiler Feed Water . . .
Hot Water Supply . . .
Refrigerating Brine . . .
Cooling and Condenser Water . . . Rapid Scale Removal . . . Coagulation . . . Algae Control

LINES CORAVOL BOILER

The use of **CORAVOL** saves you costly pipe repairs, replacements, maintenance labor, hours and days of shutdown loss. **CORAVOL** (1) *prevents corrosion* in steam and condensate lines, (2) *cleans out* clogging rust deposits already present. Thus, **CORAVOL** *protects lines;* increases effectiveness of heat transfer surfaces; restores original capacity of lines and the operating efficiency of valves and traps.

CORAVOL is NOT a boiler feedwater treatment. It is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates thruout your entire steam system and protects *all* zones from corrosive attack.

For 8 years, **CORAVOL** has proved its value in hundreds of steam heating, process and power plants in more than 20 different industries.

Mail the coupon TODAY for complete FREE data about the **CORAVOL** process.

MAIL TODAY

WESTERN CHEMICAL COMPANY
715 Washington Street — Kansas City 6, Missouri

Without obligation to me, please send complete data on the CORAVOL Process

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY AND STATE _____ (1)

Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin, has reappointed F. S. Cockburn as field representative of the company in Peru, a position he held prior to the outbreak of World War II. In his new assignment he will work in conjunction with distributors for Peru, The Peruvian Trading Corp., Ltd., South America. He will be located in Lima, Peru.

R. H. Elliott has been appointed by Westinghouse Electric Supply Co. as District apparatus and supplies manager, with headquarters in Philadelphia, Pa. He has held a similar position at Pittsburgh.

Hagan Corporation, Hall Laboratories and Calgon, Inc., have announced that Russell Lang, field service engineer, has joined the Hall Laboratories field service staff at Los Angeles, under Ray Sullivan. He will devote his principal efforts to boiler water conditioning aboard merchant marine vessels.

N. B. Graham, formerly vice president in charge of industrial sales for Elgin Water Softener Co., recently became associated with Graver Tank & Mfg. Co., Inc., in charge of water treating and process equipment sales in the Tampa, Fla., area.

NEWS *from* THE FIELD

Power Output of Grand Coulee

GRAND COULEE DAM power plant turned out more than 540,000 kw-hr of electric energy during March and brought its total since the beginning of operation in March, 1941, to nearly 14,000,000,000 kw-hr, Frank A. Banks, regional director of the Bureau of Reclamation, reported recently.

It was also stated that the past four years have shown a steady growth in Grand Coulee Dam's contribution to war industries consuming huge blocks of electrical energy. In 1941, the production of the power plant on the Columbia River was approximately 209,980,000 kw-hr; 1942, 1,942,000,000 kw-hr; 1943, 4,115,000,000 kw-hr; 1944, 6,051,000,000 kw-hr and the first three months of 1945, 1,560,000,000 kw-hr.

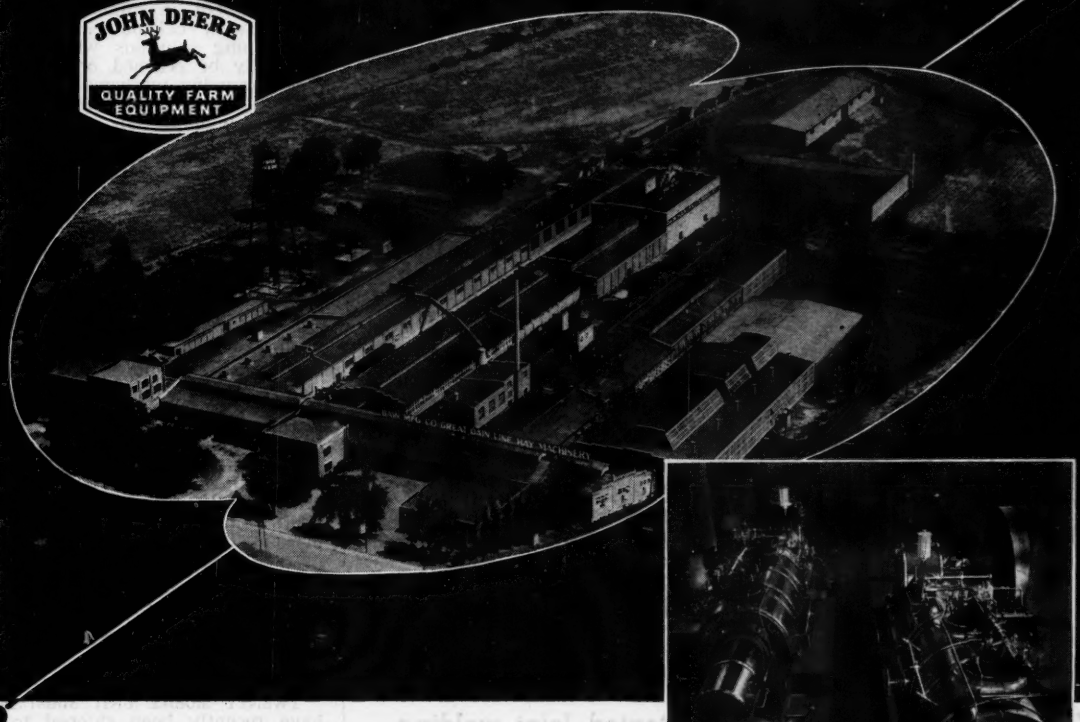
At present, only one of the two power houses at the dam has been equipped with generators and the total installed capacity of this section is 818,000 kw. Eventually the combined capacity of both power houses will be 1,890,000 kw.

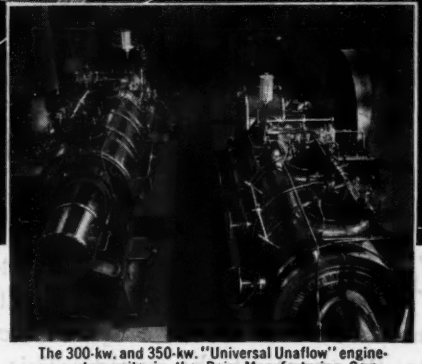
Network Calculator

Armour Research Foundation of Illinois Institute of Technology by means of a new $80,000 a-c network calculator purchased from Westinghouse Electric & Manufacturing Co., is now in position to analyze difficult problems in power system design and operation economically and accurately.

This service for such study and analysis is provided on a co-operative basis. Participating companies interested in making sure of a definite time each year, have purchased time

• FROM JOHN DEERE'S ANVIL GREW 14 GREAT FACTORIES —





SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES
Generate Electric Power in 7 of These Plants

The 300-kw. and 350-kw. "Universal Unaflow" engine-generator units in the Dain Manufacturing Company plant of Deere & Company, Ottumwa, Iowa.

FROM Vermont in 1836 a Yankee started west, carrying with him a small bundle of tools and a much smaller bundle of cash. But John Deere also carried with him a thorough mastery of the mechanic and blacksmith trades, as well as inventive genius and breadth of vision.

In the waxy, black soil of the prairies that stuck to the old-fashioned iron plows, John Deere found his opportunity. He believed that steel was the answer—and proved it. His plow, fashioned from a broken saw blade salvaged from a neighboring sawmill, was an immediate success and became known as "John Deere's Self-Polisher."

From this small beginning, over a hundred years ago, the House of Deere has been inseparably linked with agricultural equipment, such as plows, corn and cotton planters, hay machinery and scores of other items in its complete line of farm implements.

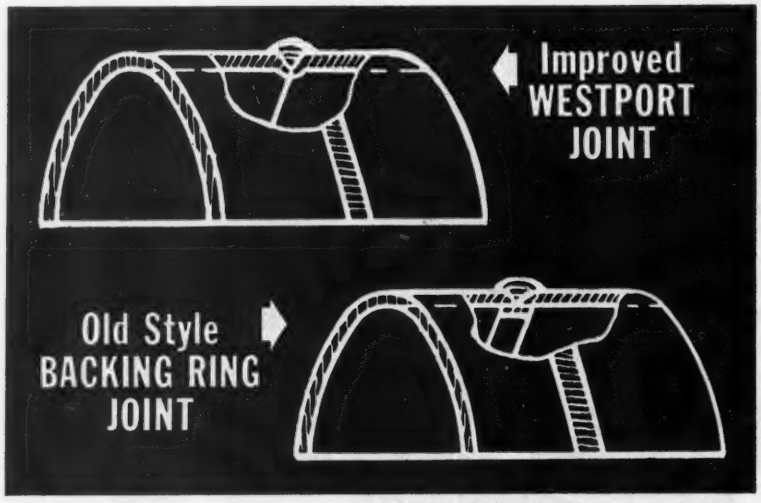
Skinner Engine Company is proud of its long and happy association with Deere & Company. Economical, dependable power is being generated in seven Deere plants by nine Skinner "Universal Unaflow" Steam Engines—with efficient use of the exhaust steam for heating and processing. This is not an unusual example, for in practically every type of industry savings are being made where far-sighted management is using Skinner engines for electric power generation. It will pay you to investigate the possibility of substantial savings in your own business. Case studies pertaining to your particular industry will be sent upon request.

Do More Than Before—Buy EXTRA War Bonds

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

Don't Weaken Your Pipes By Welding Them Wrong



THE WESTPORT JOINT

Produces *SOUND* Welds

Here's why **The Westport Patented Joint welding permits fusion buttwelded joints to be made from one side only, with complete penetration to the root of the weld. This new method . . . especially suitable in the welding of heavy wall piping for high pressure temperatures . . . is proving satisfactory in lines operating at 1250 pounds per square inch and 925 degrees F. total temperature steam service, on installations made as early as 1939.**

The Westport Welded Joint provides:

(1) Greater Flexibility in Alignment of pipes, valves and fittings.
(2) Complete penetration to root of weld.
(3) No constriction in pipe area due to Backing Rings.
(4) No sacrifice in strength of the pipe due to removal of wall or Backing Ring.
(5) Smooth pipe contour at base of weld with no "icicles" or protrusions.
(6) Meets A.S.M.E. Code Requirements.

1899 M 1945

WRITE FOR BULLETIN AND DETAILED LITERATURE WITHOUT DELAY

W. K. MITCHELL & CO., Inc.

PHILADELPHIA 46, PENNA.

on a unit basis. One unit permits the use of the board for one week each year for a period of 12 years. Seventeen Mid-west companies have thus far made up the sponsor group.

Characteristics singular to any one power system can be reproduced in exactness but in miniature on the a-c network calculator. Hence, in determining solutions which would ordinarily be reached only through time-consuming mathematical manipulations, an electrical engineer can set up in miniature an interconnected power system representing major transmission lines extending for hundreds of miles and measure the distribution of power and voltages at different stations under various conditions.

Circuit elements are available to represent simultaneously 12 generating stations, 100 transmission lines or transformers, 40 loads and 18 variable ratio transformers. Engineers analyzing power system operation can, from the readings on the board, determine the effect of additional loads, methods by which additional loads may be carried, or the system changes that can be made. The miniature system reproduced on the board can be adjusted to simulate any operating condition on the power system itself. Since accurate measurements are possible at all points, the effect of changes in equipment or conditions can be forecast economically and correctly.

Mobile Substations for U.S.S.R.

TWENTY MOBILE UNIT SUBSTATIONS have recently been shipped to the Union of Soviet Socialist Republics by General Electric Co. Designed and manufactured to restore electric power in devastated areas and towns until local equipment can be placed in service, these units are the first complete, trailer-type substations to be exported for service in war-torn areas. Ten of the units are rated 1000 kva and the remainder are rated 1800 kva.

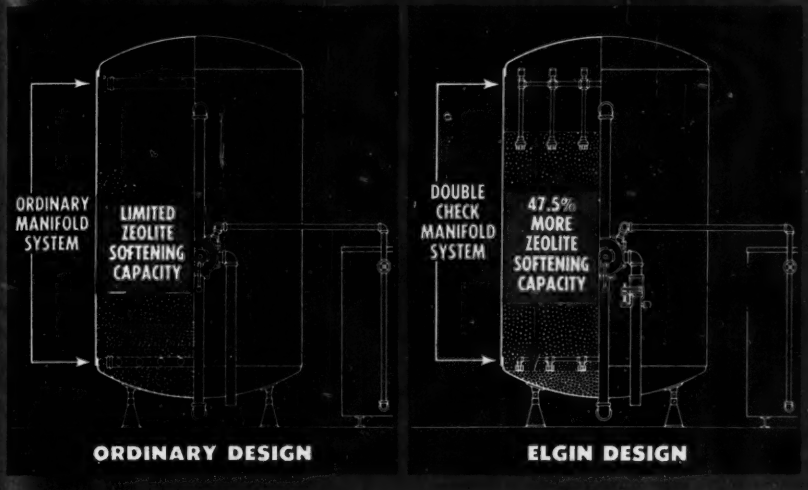
Each unit is an entirely self-contained electric substation, and includes a disconnecting switch for the incoming high-voltage line, high-voltage power fuses, lightning arresters, a three-phase power transformer, and a metal-clad switchgear equipment for two or three outgoing feeder circuits—all mounted on a heavy-duty, eight-wheeled, highway-type trailer. The trailers may be drawn by suitable trucks or tractors, and are capable of traveling at a speed of 40 mph over paved highways.

The substations have a high-voltage rating of 35,000-v, and can be used throughout Russia because this subtransmission voltage has been standardized. This voltage may be stepped down to either 3150 or 6300-v. The high-voltage switch and fuse equipments, as well as the metal-clad switchgear equipments, were manufactured as complete sub-assemblies.

The transformers are of the self-cooled type with supplemental cooling fans. Operating attention has been minimized by the use of transformer thermal relays which automatically start the cooling fans when required, sound an alarm if the transformer loading produces an abnormal temperature rise, and trip the feeder cir-

ELGIN WATER SOFTENER

gives 12,600 gallons more soft water



ELGIN FEATURES

- Delivers up to 50% more soft water
- Prevents loss of zeolite
- Requires less salt
- Assures better backwashing
- Costs less per thousand gallons

HERE is a typical example of Elgin performance. The two water softeners diagrammed above are identical in size (36" x 72"). Each uses synthetic zeolite to soften ten-grain water. In actual performance, the Ordinary Design softens only 26,500 gallons of water per regeneration, while the Elgin Design softens 39,100 gallons of water per regeneration. Think of it—12,600 gallons or 47.5% more soft water with the Elgin!

The reason for this remarkable increase in soft water output is shown in the illustrations above. Note the far greater zeolite content of the Elgin — made possible by an ingenious "Double-Check" manifold system. This design makes the deeper bed possible without loss of zeolite—a loss that the ordinary water softener attempts to avoid during backwashing by using a shallow zeolite bed, as illustrated.

Of course, more zeolite means more soft water output, for it's the zeolite that softens water. But the "Double-Check" manifold system goes beyond that . . . prevents zeolite loss . . . permits zeolite to be washed cleaner . . . prevents packing and channeling of the bed. Thus the brine reaches every granule of zeolite, producing more efficient regeneration with less salt consumption.

INCREASE THE SOFT WATER OUTPUT OF YOUR PRESENT WATER SOFTENER WITH "DOUBLE-CHECK" MANIFOLD SYSTEM

The "Double-Check" manifold system can be quickly installed in water softeners of any make. This change supplemented by remarkable high capacity ELGIN ZEOLITE *when required will greatly increase soft water output and operating efficiency. The cost of such modernization is surprisingly low.*

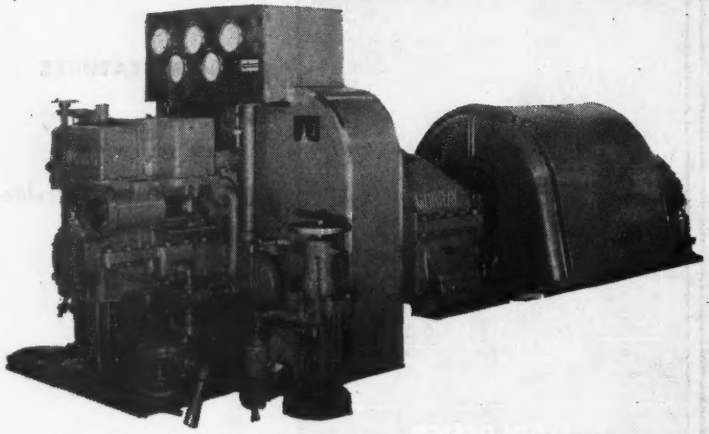
For facts about the Elgin Water Softener or modernization of your present water softener, write for Bulletin 403.

ELGIN SOFTENER CORPORATION, 136 N. Grove Ave., Elgin, Ill.

ELGIN
ECONOMICAL WATER CONDITIONING

WATER CONDITIONING FOR EVERY NEED

FOR POWER
MURRAY
TURBINE GENERATORS



Do you need additional POWER? Are you losing POWER by allowing steam to go through reducing valves to process? Have your plant changes thrown your plant heat balance off from the way it should operate?

Correct the situation with a MURRAY STEAM TURBINE GENERATOR SET, properly designed for your present operating conditions. Whether your plant needs a straight non-condensing unit, or one designed for bleeder or mixed pressure operation, MURRAY has already built a similar macine, now in satisfactory operation for a number of years, among the numerous machines furnished industrial and municipal plants.

There is a MURRAY sales representative near you, ready to serve you, with information or guidance in planning.

MURRAY also produces:

Multistage and single stage Mechanical Drive Turbines
Verticle single stage turbines
High Speed Reduction Gears
Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

How 266 Field Calls Help Us Help You . . .

DURING the last three years POWER PLANT ENGINEERING'S field staff has been ringing a lot of power plant doorbells, crawling under steam pipes, gathering first-hand reports from readers about their varied problems of operation and maintenance . . . The purpose of these continuing on-the-job chats—which total 266 to date—is to make sure that our magazine is geared to the practical needs of our readers.

cuit breakers to remove the load and protect the transformer before an excessive temperature is reached.

Johns Hopkins University has recently opened a Maritime Training School for engineer officers of the merchant marine, under the War Shipping Administration. The new course is to last four weeks per group and is designed to instruct maritime engineer officers on combustion control of boilers and similar subjects. Hall Laboratories of Pittsburgh has been designated to give instruction in chemical combustion control.

David E. Acker, chemical engineer, has recently joined the staff of Arthur D. Little, Inc., Cambridge, Mass., industrial research organization. Mr. Acker was previously associated with the B. B. Chemical Co.

The ASTM Executive Committee at its meeting on April 10 decided to cancel the five-day regular Annual Meeting of the Society (scheduled for Buffalo, June 18-22 incl.) and instead to plan for a business session or sessions to be held probably the last week in June in New York City. This will permit actions on the formal standards to be consummated and Society business to be conducted. Also cancelled is the Exhibit of Testing Apparatus and Related Equipment which had been scheduled for the Annual Meeting. These actions were taken in full cognizance of the transportation situation and after consultation with officials of the Washington Committee on Conventions and the ODT. The Society will proceed with the printing of its technical papers and reports that would normally have been presented and these will be distributed to the members as is customary. The Society's technical committees are holding meetings at various times and places and its work on specifications and tests for materials continues intensively.

The name of the Steel Heating Boiler Institute, Inc., has officially been changed to Steel Boiler Institute, Inc. The membership of this Institute includes manufacturers of various types of steel heating and power boilers and it has been thought that the use of the word "Heating" in the name implied restrictions on the products of the manufacturers which do not exist.

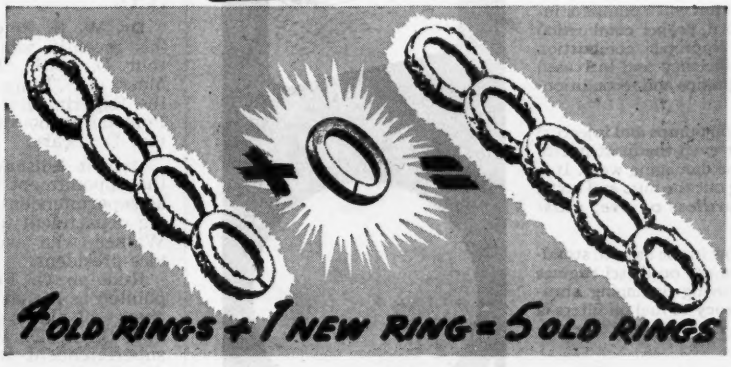
The reports made by United States Rubber Co. show that the production of special synthetic rubber latex now exceeds one and one-half million pounds per month at the Government's latex production plants, operated for Rubber Reserve Co. This liquid form of synthetic rubber replaces natural rubber latex where it was used in the manufacture of most synthetic rubber tires, and in fabric and paper impregnation.

Nearly ten million pounds were produced last year, at the Naugatuck plant and production by the end of this year is expected to reach two million pounds per month. This production compares with a nation-wide pre-war consumption of natural rubber latex of six million pounds per month just before the war.

Synthetic rubber properties are being continuously improved and it is highly essential in many military as well as industrial applications.

To get the most out of a repacking job...

1. REPLACE *all* OLD PACKING



Adding a new ring or two to the old packing in a stuffing box is like adding a quart of new oil to the old, worn-out oil in your car's crankcase. It doesn't do much good. To get a packing job that will *last*—and give proper protection against scoring, (1) remove all old rings, (2) clean out the stuffing box and (3) replace with all new packing. Finally, make sure each ring is properly seated before installing the next one.

2. CUT RINGS FROM J-M KEARSARGE ROD PACKING—

NO NEED TO WORRY about too-frequent repacking when you use Kearsarge! For here is one rod packing that won't *wear* out or *dry* out in a hurry.

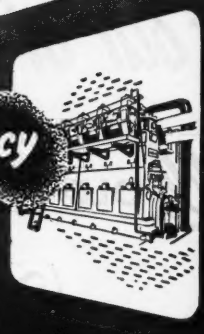
Designed for use against high pressure steam, Kearsarge retains its original pliability and resiliency even under continuous high temperature and high pressure service. The reason is found in its unique construction—an accordion-folded center block of asbestos cloth which forms a natural "reservoir" for the preserving lubricant and keeps the packing pliable. Additional resiliency is provided by a red rubber expansion back in the center block. Around this is a double wrapping of asbestos cloth to assure resistance to wear.

Kearsarge is one of many Johns-Manville specialized packings which are minimizing shutdowns and helping speed production in thousands of plants today. If you have a packing problem, write Johns-Manville, 22 East 40th Street, New York 16, New York.

Johns-Manville **PACKINGS & GASKETS**

THERE'S A DISTRIBUTOR NEAR YOU

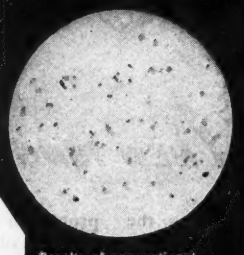
DIRTY FUEL OIL DESTROYS Diesel Engine Efficiency



● Every operator knows that when pumps or injection parts become worn, proper combustion is seriously impaired. Improper combustion means lowered engine efficiency and increased maintenance in lapping pumps and reconditioning injection parts.

The tolerances in fuel oil pumps and injection parts are so precise that even the most microscopic abrasive will cause damaging wear. It is not a matter of straining out the nuts and bolts, but *all abrasives, regardless of size, must be removed.*

Many fuel oil filters now in use as both standard and auxiliary equipment on diesel engines are not capable of removing damaging abrasives. The relative efficiency of fuel oil filters is graphically presented in Figures 1 and 2 below.



Results of conventional strainer type filter

FIG. 1—Micro-photo shows 45 times enlargement of the abrasives in one cc. of refined fuel oil. Sample taken after it had passed engine filter ready for injection. Chemical analysis showed—Moisture 3.5%, sediment .035%, tarry matter .0475%.

Results accomplished by Honan-Crane Fullers Earth fuel oil Purifier

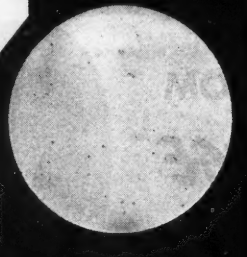


FIG. 2—Micro-photo shows 45 times enlargement of contamination in one cc. of the same refined fuel oil after passing one time, full flow, through Honan-Crane Fuel Oil Purifier. Chemical analysis showed—Moisture .005%, sediment .0035%, tarry matter .003%.

● It is important that any operator of diesel engines check the efficiency of his fuel oil filtering or purifying facilities. Proper combustion will quickly pay for the change to an efficient fuel oil filtering system.

Honan-Crane fuel oil purifiers are available for direct connection or bulk station use for the purification of both refined and crude fuel oils. Write for complete information and engineering bulletin on purification of Diesel Fuel Oils.

HONAN-CRANE CORPORATION

Subsidiary of Houdaille-Hershey Corporation

301 INDIANAPOLIS AVENUE, LEBANON, INDIANA

Cuts your gasket costs in half

The most remarkable tool ever invented.

Write for Booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere ***Mamaroneck, N. Y.***

The Bureau of Statistics of the U. S. Department of Labor has recently published a 44-page pamphlet entitled, "Improvement of Labor-Utilization Procedures." The pamphlet treats the matter of absenteeism among workers, labor turnover, training and upgrading, shift schedules, supervision and wage structures. Working conditions and safety are also considered. Copies of the pamphlet designated as Bulletin No. 807, may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Dr. W. B. Pings, organic chemist, has recently joined the staff of Arthur D. Little, Inc., of Cambridge, Mass. Dr. Pings was previously at the Experimental Station of E. I. du Pont de Nemours & Co. at Wilmington, Delaware.

Detroit Edison Co. has announced the appointment of Ernest E. Dubry as superintendent of the central heating department to succeed J. Herbert Walker who was recently elected vice-president.

Rudolph G. Felger has been appointed as assistant superintendent in charge of plants and coaling stations, and Glenn D. Winans as assistant superintendent in charge of steam distribution and customer relations. All three men have had many years experience in the central heating department of Detroit Edison and are registered engineers.

Gates, Moe and Weiss is the firm name of a recently organized consulting engineering company whose offices are located at 611 North Broadway, Milwaukee 2, Wis. The principals in this company are Samuel J. Gates, Parker A. Moe, and Robert H. Weiss, all of whom have had many years experience in the practice of engineering as consultants and operating specialists.

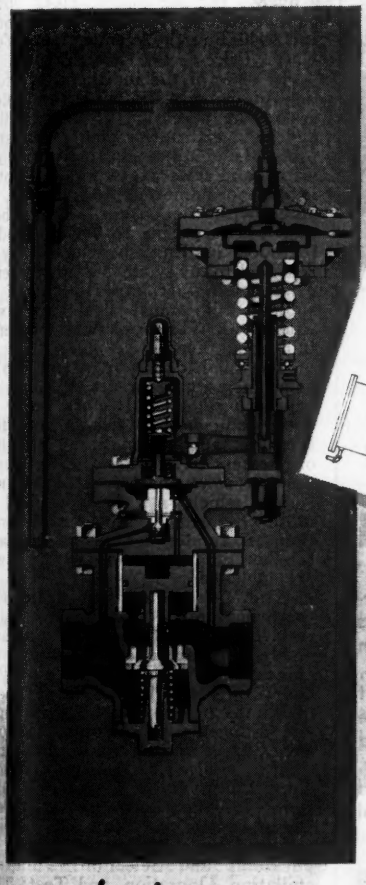
New ENGINEERING BOOKS

Seamless Steel Tube Data Book. Prepared by the Seamless Steel Tube Institute, Pittsburgh 19, Pa. Copyright, 1944, 8½ by 11-in., 320 pages, loose-leaf binder. Price $2.50.

Inasmuch as the information in this book will be subject to revision from time to time and as it has been assembled as a service to manufacturers and users of equipment employing carbon-steel and alloy tubing, a loose-leaf arrangement has been used for it is thought to be the most convenient type of binding for this type of book. It is stated in the foreword that while it is believed the data presented herein will meet the broad requirements of a useful reference book, it has been impractical to include in a single publication all the available information bearing on the subject. The Institute offers, therefore, to be a source guide for further data on seamless steel tubing and its many applications which the users of this book may desire.

The book is divided into four principal sections with guide index, covering General Data; Mechanical Tubing; Pressure Tubing and Reference

"We can simplify our piping...cut installation costs—and CONTROL BOTH Temperature and Pressure"...



...with the LESLIE TRADE MARK REG. U. S. PAT. OFF.

TEMPERATURE REGULATOR

SELF-CONTAINED

Anywhere in your plant—wherever you want to guard your least or your most important processes with BOTH accurate temperature regulation and pressure control, simultaneously—you can easily and quickly install the Leslie Temperature Regulator with the assurance of absolute dependability of results.

• *EXTREME ACCURACY AND SENSITIVITY*

This Regulator was designed for accurate, dependable control where other regulators failed. In brief, it holds temperatures *constant*, in the closest limits, with the *minimum* expenditure of steam.

• *MAY WE HELP YOU?* Leslie Engineers are prepared to work with you to help you select the correct type of Leslie product for your needs and to advise you regarding the most effective methods of installation. When writing please give *complete details* as requested in our bulletins.

features...

DUO-MATIC CONTROL—Temperature Regulation and Pressure Reduction with a SINGLE regulator

WIDE RANGE, RUGGED THERMOSTATIC ELEMENT—100°F adjustable temperature.

SINGLE SEATED for positive dead-end control

METAL DIAPHRAGMS—No bellows or packing glands

RENEWABLE WEARING PARTS—100% interchangeability

CORROSION & WEAR RESISTANT—Stainless Steel Hardened Wearing Parts.

FOR COMPLETE DETAILS WRITE FOR BULLETIN 404A

LESLIE CO. • LYNDHURST • NEW JERSEY

Proved power and endurance for cleaning small tubes

The Roto Company
Newark, N. J.

Gentlemen:

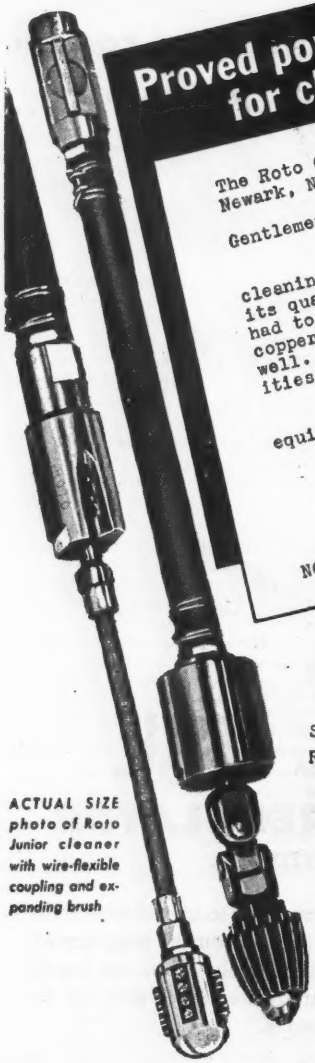
On receipt of your miniature tube cleaning equipment, I was a bit dubious of its qualifications to carry out the job it had to do. It has cleaned 4,000 3/4"x 24' copper-nickel tubes, and has done this job well. All suspicions of its staying qualities have been removed.

I can heartily recommend this equipment. Thanking you.

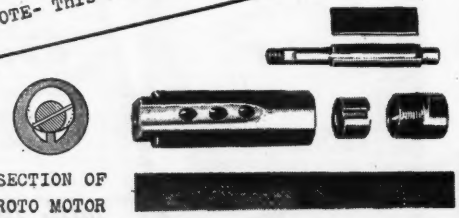
Yours respectfully,

(Signed) Chief Engineer
(Large municipal power plant)

NOTE- This is unsolicited



ACTUAL SIZE photo of Roto Junior cleaner with wire-flexible coupling and expanding brush



SECTION OF ROTO MOTOR

The Secret of the power and endurance of the Roto Junior Tube Cleaner is its extreme simplicity of design and precision construction. It has only two moving parts, a shaft and a solid blade. Positive contact between the blade and the Rotocentric bore cylinder assure an undivided air stream and freedom from leakage. Its convenient size, speed and ease of operation, offer a marked contrast with old type, cumbersome external cleaners. Send for details.

ROTO Junior Tube Cleaners

ROTO Division of Elliott Company 145 Sussex Ave., Newark , N. J.

TEMPLETON RETURN STEAM TRAPS

for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

- Pumps Water at any temperature or pressure.
- Open float cannot burst or waterlog.
- Valves and Seat Bronze or Stainless Steel.
- Sizes 1 in. to 4 in. inlet and outlet.
- Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.

Ask for catalogue and prices

TEMPLETON BROS., INC.
699 Main St. Walpole, Mass.

Tables. The book is intended to be of practical use to engineers in the field with useful tables and with only sufficient text matter to make the using of the data convenient for the reader. It is thought to be the most complete volume on this subject issued for many years and supplementary sheets with new data will be supplied from time to time.

Centrifugal Pumps and Blowers. By Austin H. Church. Copyright 1944; 6 by 8½ in.; 308 pages; cloth cover; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y. Price $4.50.

In view of the indispensable function of centrifugal pumps and blowers in the operation of public utility and industrial power plants, industrial processes of all kinds, municipal gas, water, and sewerage works, and other fields too numerous to mention, we agree with the author of this book that it is surprising to find no modern textbook in English which may be referred to by young graduate engineers or in fact any student of the subject who must deal with such equipment. This book was written to fulfill that need.

The book does not attempt to develop new theories nor go into advanced problems. It does cover the basic principles of design, construction and application along the lines of present-day practice. References are given to many recent technical papers which may be consulted for more complete or advanced information. Examples are given to clarify the text and problems with answers are included.

The book begins with an introductory chapter on centrifugal machines, reciprocating machines, and operation and nomenclature of centrifugal machines. Then follow chapters on Principles of Fluid Flow; Basic Theory of Pumps and Blowers; Specific Speed and Efficiency of Pumps; Performance Curves and Cavitation of Pumps. Chapter 6 discusses Design of Radial-Type Pump Stage; Chapter 7, Other Pump Impeller Types; and Chapter 8, Pump Details and Materials. This is followed by chapters on: Pump Applications and Selection; Pump Installation, Operation, and Test; Thermodynamic Principles; Classification and Performance Curves of Blowers; Design of Radial-Type Blower Stage; Construction Details of Blowers; Blower Applications; Regulation of Blowers; Blower Installation, Operation, and Test; and the two final chapters deal with Disk Stresses and Critical Speeds. The book is well indexed.—C. R. E.

Results of Publicly-Owned Electric Systems. By Burns and McDonnell Engineering Company. Copyright 1944; 6 by 9 in.; 447 pages; paper cover; plastic back; published by the Burns and McDonnell Engineering Company, Kansas City, Missouri. Price $10.00.

The new eighth edition, 1944, of this well-known electric rate book shows the operating records, earnings, output, rates, net revenue, valuation, and other information as to the use and cost of electricity in 767 publicly-owned systems.

The new volume of 447 pages has interesting graphs and tables showing the rates and revenues. This edition

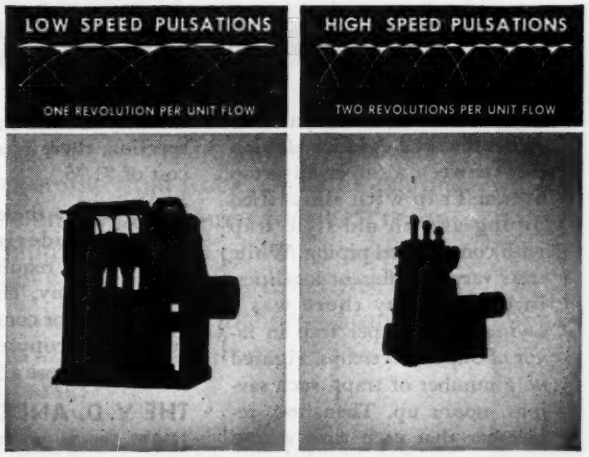
What are the advantages of High Speed Operation in reciprocating power pumps?

For a given delivery requirement, the higher the pump operating speed, the smaller the size pump required. Consequently, both first cost, weight, amount of floor space and foundation needed are less on high-speed designs. Furthermore, in high speed units there is less pulsation, less noise and less wear. Simple, low-ratio gear-reducers or direct-coupling to prime movers are practical with high operating speeds, and efficiencies are naturally improved.

Why then, if high speed design is so desirable, aren't all such pumps designed on this basis? The answer is that it takes unusual skill, design experience and manufacturing standards to build pumps that will stand up, year after year, under the stresses of relatively high speeds. Extra weight must be eliminated without sacrifice in strength. Balance, both static and dynamic, must be near-perfect. Tolerances must be small and finishes flawless. Lubrication must be adequate and unfailing under trying conditions, while valves and passages must be designed to minimize pressure losses in the fluid end.

Throughout its more than 40 years of experience in the design and manufacture of power and hydraulic pumps, Aldrich has consistently led the way to higher and higher operating speeds. Why not get in touch with Aldrich engineers for assistance in the solution of your pumping problems? *The Aldrich Pump Company, Allentown, Pennsylvania.*

RELATIVE PUMP SIZE AND FLOW CHARACTERISTICS FOR A GIVEN DELIVERY REQUIREMENT



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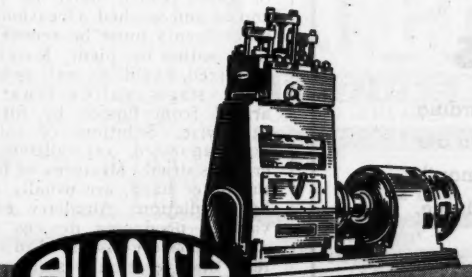
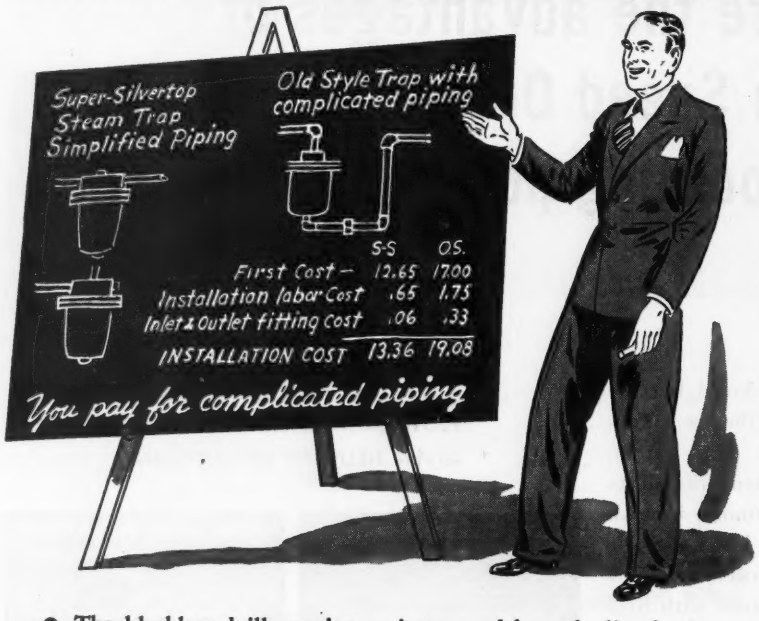


ALDRICH . . . anticipates industry's pumping needs

Chalk Talk No. 1

ON POSTWAR STEAM TRAP ECONOMY


Super-Silvertop Steam Trap Simplified Piping
Old Style Trap with complicated piping
S-S
OS.
First Cost — 12.65 17.00
Installation labor Cost .65 1.75
Inlet & Outlet fitting Cost .06 .33
INSTALLATION COST 13.36 19.08
You pay for complicated piping

● The blackboard illustration shows the savings in installation cost between a Super-Silvertop Steam Trap with simplified piping and an old-style trap with complicated piping. While costs vary in different localities, in one locality there was a saving of $6.72 per trap in favor of Super-Silvertops. Figured on a number of traps, such savings mount up. Then, too, remember that each time a trap is removed from the line for inspection, there is an additional cost of $1.75.

Think about these economies when considering postwar Steam Trap requirements. For true economy, choose Super-Silvertops. For complete details, send for a copy of the book, "How to Choose a Steam Trap."

THE V. D. ANDERSON CO.
1939 W. 96th St. • Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS

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POWER PLANT ENGINEERING

also covers new information showing a comparison of the rates of both private and municipal plants in every city of over 5000 population. Over half the publicly-owned systems in the country have lowered their rates since the 1941 edition was issued. A majority of the 767 systems report "no bonded indebtedness." The type of plant, whether steam, diesel or hydro, and its form of management are recorded. Every complete record received from publicly-owned systems has been recorded. Therefore, the 767 systems represented may be considered a cross-section of what publicly-owned systems are doing in producing and selling electricity.

City officials, operators, and managers of both private and municipal power systems will find these operating records of much interest and value. It is the only book of its kind published, giving rate schedules and reliable statistics of public operation.—C. R. E.

Chemical Machinery. By Emil R. Riegel. Copyright 1944; 6 by 9 in.; 583 pages; cloth cover; published by the Reinhold Publishing Corp., 330 West 42nd Street, New York, N. Y. Price $5.00.

Here is another splendid book by Emil R. Riegel, Professor of Industrial Chemistry at the University of Buffalo, that should prove a most valuable and interesting companion volume to his well known Industrial Chemistry, the 4th Edition of which was reviewed on page 178 of the September, 1943, issue of POWER PLANT ENGINEERING.

The present book is an elementary treatise on equipment for the process industries and should be particularly valuable to engineers and engineering students who want to learn something about equipment used in processes with which they do not have direct personal contact. In contrast to Industrial Chemistry, which dealt with the chemical processes and reactions themselves and products resulting from them, this book on Chemical Machinery is almost entirely descriptive covering the various devices and apparatus used in the chemical industries.

The order in which they are described is meant to follow the sequence of events in the chemical plant. From the stock pile or quarry, solid raw materials go to crushers, grinders and screens and then by conveyors to the reaction vessel. For liquid raw materials the storage tank is the starting point, after which pumps and perhaps proportioning devices are required. The same is true of gases which must be propelled, cooled and washed. Occasionally volatile solvents must be recovered from them within the plant. Materials must be mixed, liquids as well as solids. At other stages solids must be separated from liquids by filtration or otherwise. Solutions of solids must be evaporated, crystallized and the crystals dried. Mixtures of liquids, on the other hand, are usually separated by distillation. Auxiliary equipment, vacuum producing devices and heat exchangers are discussed in two chapters, and reaction vessels, especially, kettles, are more closely examined subsequent to that. The three con-

(Continued on page 200)

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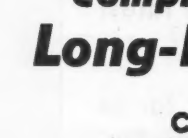
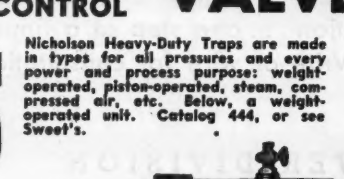
Complete Line of Dependable
***Long-Life* STEAM TRAPS**
AND
CYLINDER CONTROL VALVES



Nicholson Heavy-Duty Traps are made in types for all pressures and every power and process purpose: weight-operated, piston-operated, steam, compressed air, etc. Below, a weight-operated unit. Catalog 444, or see Sweet's.



Nicholson Industrial Thermostatic Steam Traps (Type C above) show, in plant tests, substantially greater drainage capacity than any units in their price range. 5 types; ¼" to 2". Bulletin 544.

Nicholson Cylinder Control Valves (above); standard types for many applications. For air, steam, oil, gas, tar or water. Also lever, foot, solenoid and motor-operated types. Catalog 543.

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POSITION WANTED: Stationary engineer with many years experience desires permanent connections with progressive industry. Experience includes plants with generating capacity up to 250,000 pounds per hour, and operating at 650 Psi, 300 deg. F. superheat. Experience also includes electrical generation and refrigeration. Age 42. Address Box 1476, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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750 to 1250 kw capacity, 2300 v, 3 phase, 60 cycles, with direct-connected exciter, for operation 150 psi. Not over 15 years old. Give full particulars re same and any available condensing equipment.

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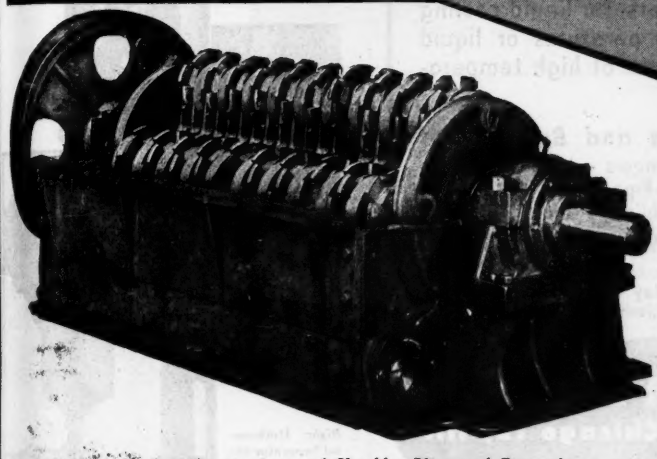
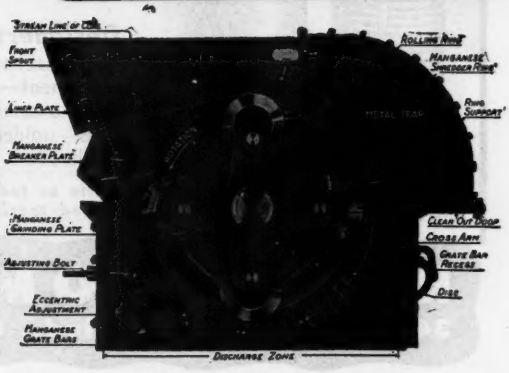
Stock Exc. Bldg., Philadelphia 2, Pa.

WHY THE AMERICAN *Ring* CRUSHER WAY is the Economical way *to better coal sizing*



Lower Half of Crusher Showing Patented Shredder Rings and Eccentric for Adjusting Grinding Plate



Cross-sectional View of AMERICAN Ring Crusher

These features help reduce R.O.M. or Lump to proper combustion size in ONE operation

One of the surest and most economical ways to get the better coal sizing you need to reduce steam generating costs is to install AMERICAN *Ring* Crushers. They reduce in *one operation* run-of-mine or lump coal to the proper sizes for unit pulverizers and automatic stokers.

As shown in the views above, the "AMERICAN" differs from any other type of ring crusher. Feed entering the top is rolled by the rings in a downward movement against the breaker plate where primary reduction takes place. Final reduction is accomplished against an adjustable grinding plate where any oversize is eliminated by grate bars or screen plates.

The rotor in the "AMERICAN" consists of a heavy alloy steel main shaft to which are keyed steel discs and spiders or cross arms. The shafts supporting the rings are of high carbon steel and the rings are installed in staggered arrangement covering the entire grinding surface of the machine. The patented shredder rings *split* the coal rather than crush it.

Guaranteed Performance

The many successful installations of "AMERICANS" in industrial plants, central stations and service establishments of all kinds are the result of the thoroughness with which our engineers study individual plant requirements before making a recommendation. On the basis of our recommendations, "AMERICANS" are guaranteed for definite performance. Let us co-operate on your coal crusher problems.

Rings in the "AMERICAN" Ring Crusher—weighing 27 lb. each—are of manganese steel. These rings apply centrifugal force to strike, roll and grind.

LESS THAN 1c PER TON

The patented scraper and shredder rings of the "AMERICAN"—an exclusive feature—splits the coal and prevents clogging. The action of the rings in the "AMERICAN" is largely responsible for the low cost per ton of finished product. Coal can be crushed to stoker size at a total cost of less than 1c per ton for all charges.

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ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

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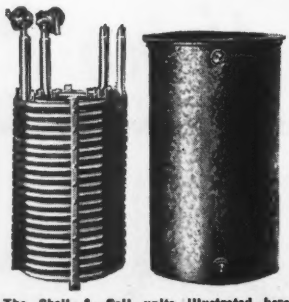
The REMPE CO. design and build units to fit your individual requirements, for liquid cooling at low temperatures or liquid heat transfer at high temperatures.

Designers and Builders of Heat exchangers — Liquid cooling equipment—Pipe Bends—Shell and Coil assemblies — multiple spiral coils—welded pipe assemblies—supply headers.

Write us today for further details or send specifications for quotation.



The Shell & Coil units illustrated here were designed and built by REMPE for dewaxing oils at 40 degrees below zero. One of the many thousands of REMPE jobs for industry.

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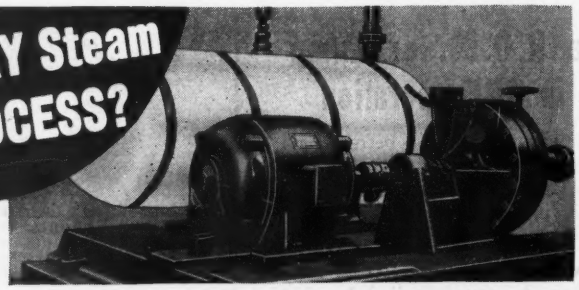
Fig. 118 All-Service Separator

Above: Vertical Separator protecting Steam Engine.

Right: Horizontal Separator removing oil from exhaust steam.

Want DRY Steam for PROCESS?



The Stout NO-VENT Boiler Return System Will Give It to You All the Time

The Stout NO-VENT System will do this without reducing valves, orifices, traps or steam reheating. By keeping the lines and condensing units continually free from condensate there is no chance for wet steam anywhere.

Operators of soy bean mills and others who thought they had to use reduced pressures in their driers, expellers and cookers to secure drier steam and hotter units are getting much better results since they discarded their reducing valves and all the other equipment for returning condensate through vented trap systems.

The Stout NO-VENT System collects condensate as fast as formed, frees it automatically of air, foul gases and non-condensibles and returns it directly to the boiler at the same pressure and temperature at which the steam is condensed, losses due to radiation and conduction excepted. It is simple, foolproof and time tested; insures hotter units and *increased production.*

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Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

Stout

Write for bulletin showing hookup of Stout NO-VENT System and giving operating details. Made in capacities 100 to 800 bhp, pressures to 200 lb. Distributors will be interested in selling franchise.

NO-VENT BOILER RETURN SYSTEM

Avoid the High Cost of

DIRTY, WET, OILY STEAM

Keep It Clean and Dry with

COCHRANE

ALL-SERVICE

SEPARATORS

You can completely remove moisture and solid entrainment from dirty, oily, wet steam, air and gases by installing Cochrane Separators. Complete purification is assured, due to exclusive design of baffles and ports which produce a direct, unrestricted fall of entrainment, prevent the purified steam from passing over the drip area, and minimize pressure loss by means of extra large port areas.

Write for details.

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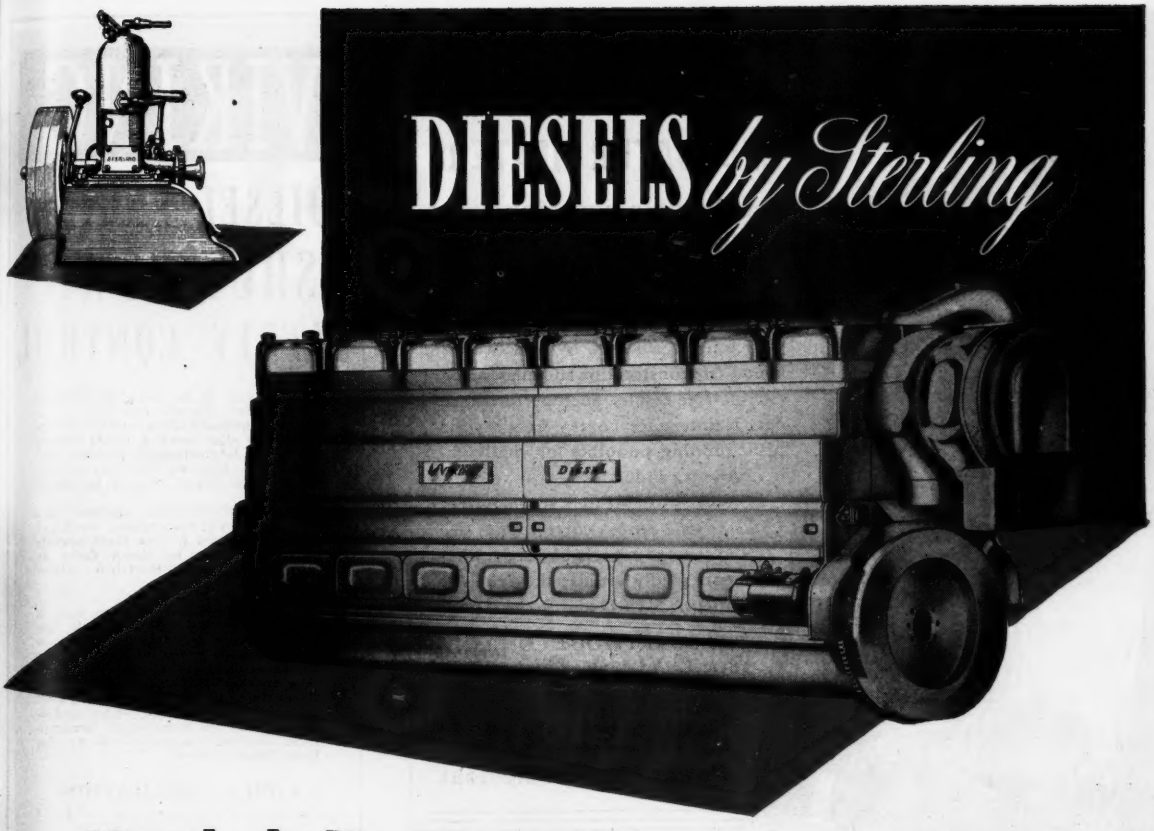

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VIKING DIESEL

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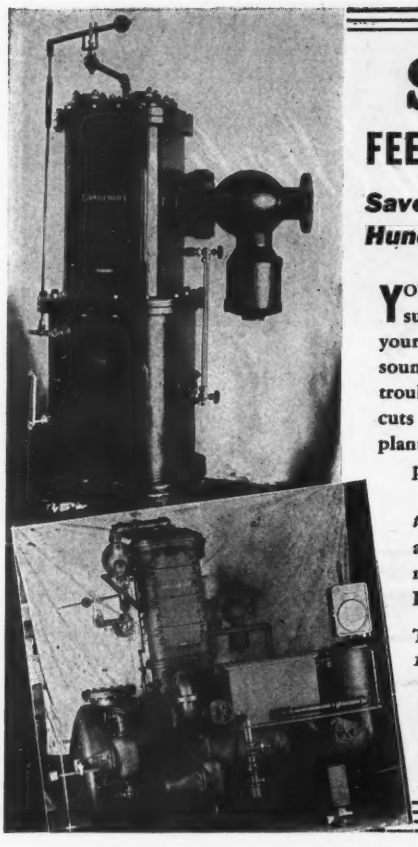

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Save Trouble and Money for Hundreds of Satisfied Users

YOU can have an adequate continuous supply of oxygen-free hot water for your boilers, assured by Swartwout's sound safe construction and guaranteed trouble-free results. Such performance cuts maintenance costs—keeps your plant running smoothly for vitally important production.

Swartwout Heaters are *engineered to fit your needs*—correct type, size and storage capacity. Your requirements gladly estimated. Write for Bulletins S-18-D and S-193.

THE SWARTWOUT COMPANY
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Swartwout
Power Plant Equipment

VIKING

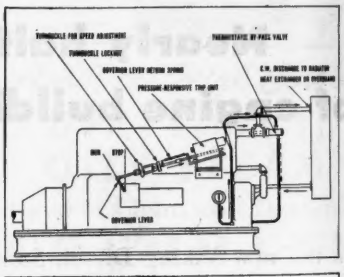
DIESEL ENGINE "SHUT-DOWN" SAFETY CONTROL

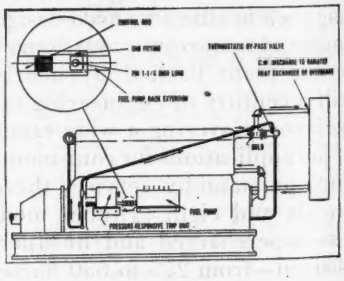
The Viking Type R-18 Shut-Down System for Diesel Engines, is a unique mechanically-operated safety control to shut down a diesel engine when (1) lubricating-oil pressure becomes too low, or (2) circulating-water temperature becomes too high.

Since it is mechanically operated this system does not require any electrical connections, and is free from operating failure due to blown fuses or other failure of electrical power sources.

A pressure-responsive bellows unit is connected in the lubricating-oil line and operates by trigger action a governor lever which shuts down the engine as soon as lubricating-oil pressure reaches the critical low point; similarly, a thermostatic by-pass valve in the circulating-water system will operate the lever when temperatures become excessive. Write for Data Sheet R-18.

TYPICAL APPLICATIONS





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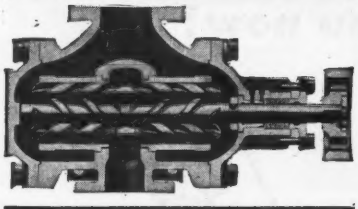

THE PUMP *without* PULSATION

The steady, uniform flow produced by the continuous turning of the rotors in an IMO pump is ideal for oil burners, hydraulic and other service requiring an even, pulsation-free flow.

For information send for Catalog 1-120-0

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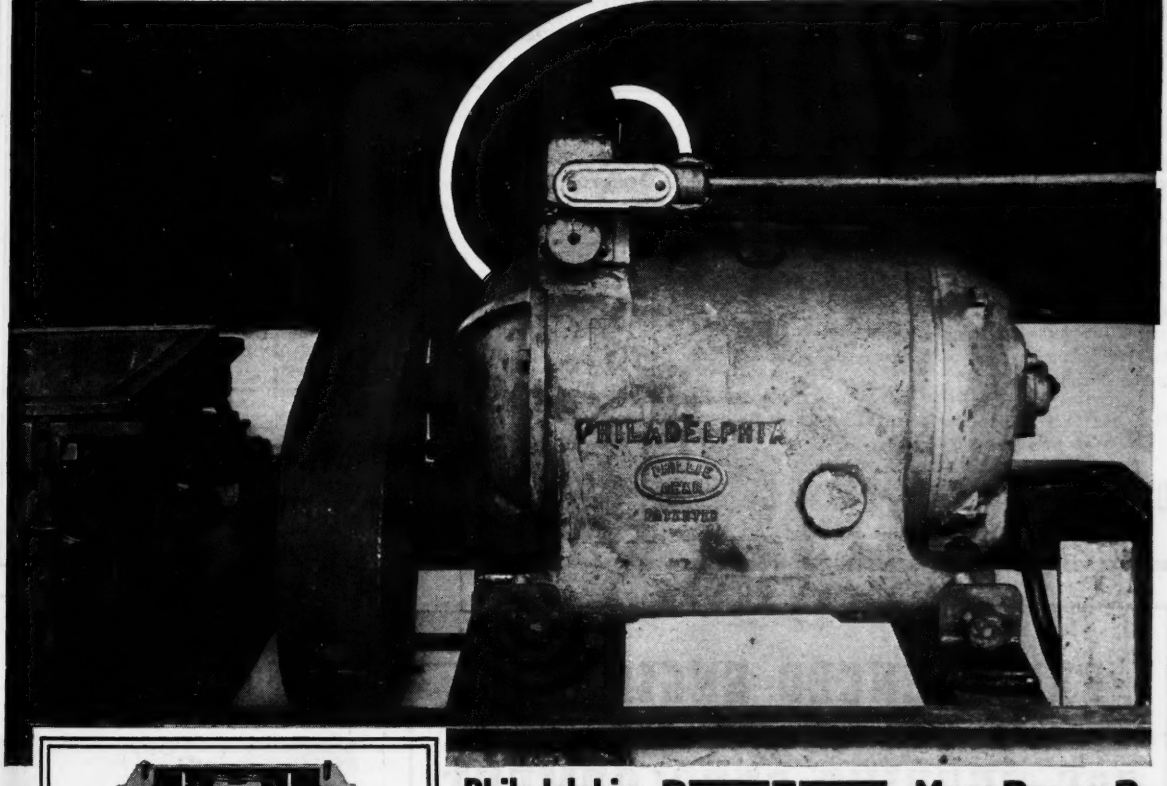
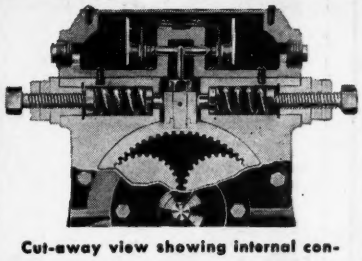
TAKE THE DUST OUT OF DUSTRY
TORNADO

UNFAILING PROTECTION





Cut-away view showing internal construction. PlaneTorque switch responds to overloads more quickly than electrical thermal relays since the mechanical action of the overload operates the cut-out switch directly.

Philadelphia PLANETORQUE-MOTOREDUCER

. . . a compact; self-contained unit that is particularly suited for driving stokers, conveyors, mixers and other equipment that may be subject to jamming or overloading. The MotoReduceR is efficient and dependable in service, truly economical in every way and in addition the PlaneTorque feature is always ready to protect the unit against the above mentioned emergencies. Whenever a predetermined load limit is exceeded, power is instantly and automatically shut off, preventing damage to either the drive or the driven equipment. Removal of the excess load makes the unit ready for service once more.

The PlaneTorque feature can be furnished on either vertical or horizontal types of MotoReduceRs which are available in a wide range of horsepowers and ratios.

For full details write for Bulletin MR 40 on your business letterhead.

ARMY E NAVY

Philadelphia GEAR WORKS INCORPORATED

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Industrial Gears and Speed Reducers
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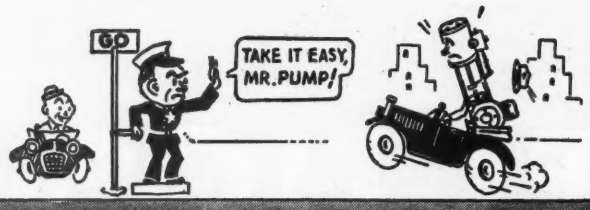


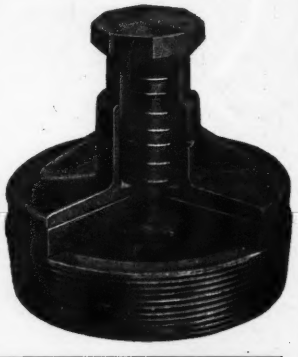
COMBINATION NON-TILT, NON-SLIP VALVES *Protect Pumps against wasteful "over-speeding"*

The tilting action of some reciprocating pump valves causes the seat to wear unevenly—which means the pump has to work faster and faster to carry its load.

COMBINATION Pump Valves enable you to get theoretical capacity out of your pumps without racing and wasting valuable steam. They prevent tilting and consequent pump slippage because they lift straight. They save on repair bills, too, because their seat, stud and springs are made of long-wearing Phosphor Bronze. Ask for descriptive folder with dimensions, prices and further information.

They Match the Fine Performance of Combination Silent Check Valves.

For Boiler Feed Vacuum, Condenser General Service



COMBINATION PUMP VALVE CO.
846 Wiota Street, Philadelphia, Pa.

LaMOTTE BOILER FEED WATER TEST UNITS

The LaMotte Research Department has developed a reliable series of chemical tests for boiler feed water control of the following constituents:

Phosphates	Dissolved Oxygen
Chlorides	Sulfates
Total Alkalinity	Hardness

pH (Hydrogen Ion Concentration)

For positive control of efficient water treatment, there is a LaMotte Unit for each constituent. Each unit is simple to operate and inexpensive to install. Write for illustrated booklet describing this equipment.

LaMotte Testing Equipment to Control Corrosion in Your Plant

LaMotte Block Comparator for pH Control

Conservation of materials from corrosion is more important today than ever before. The LaMotte Research Department has developed LaMotte pH chlorine and other corrosion control testing equipment to assist in solving this problem.

Write for copy of our Special Corrosion Control Report.

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EXPERIENCED ENGINEERS
FOR
GAS TURBINE DEVELOPMENT

The Elliott Company Research and Development Department offers unusual opportunities for work in this new field of power development. Permanent jobs and several key positions are open to:

Combustion Engineers
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Design Engineers
Test Engineers
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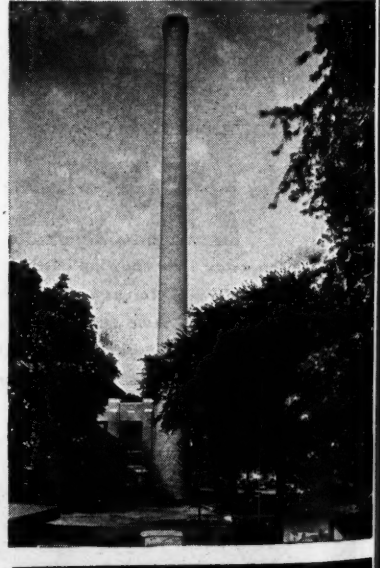
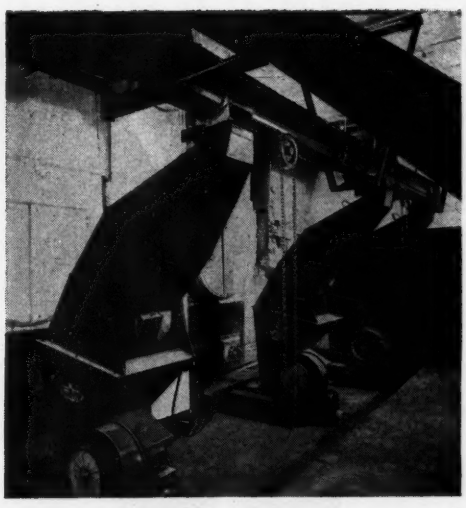
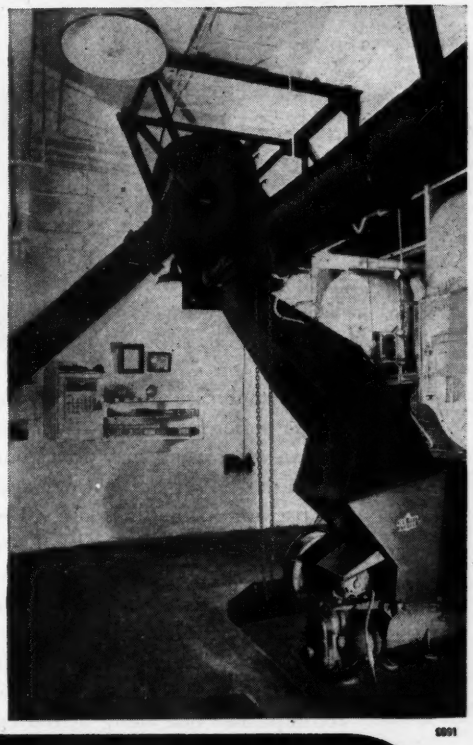
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS

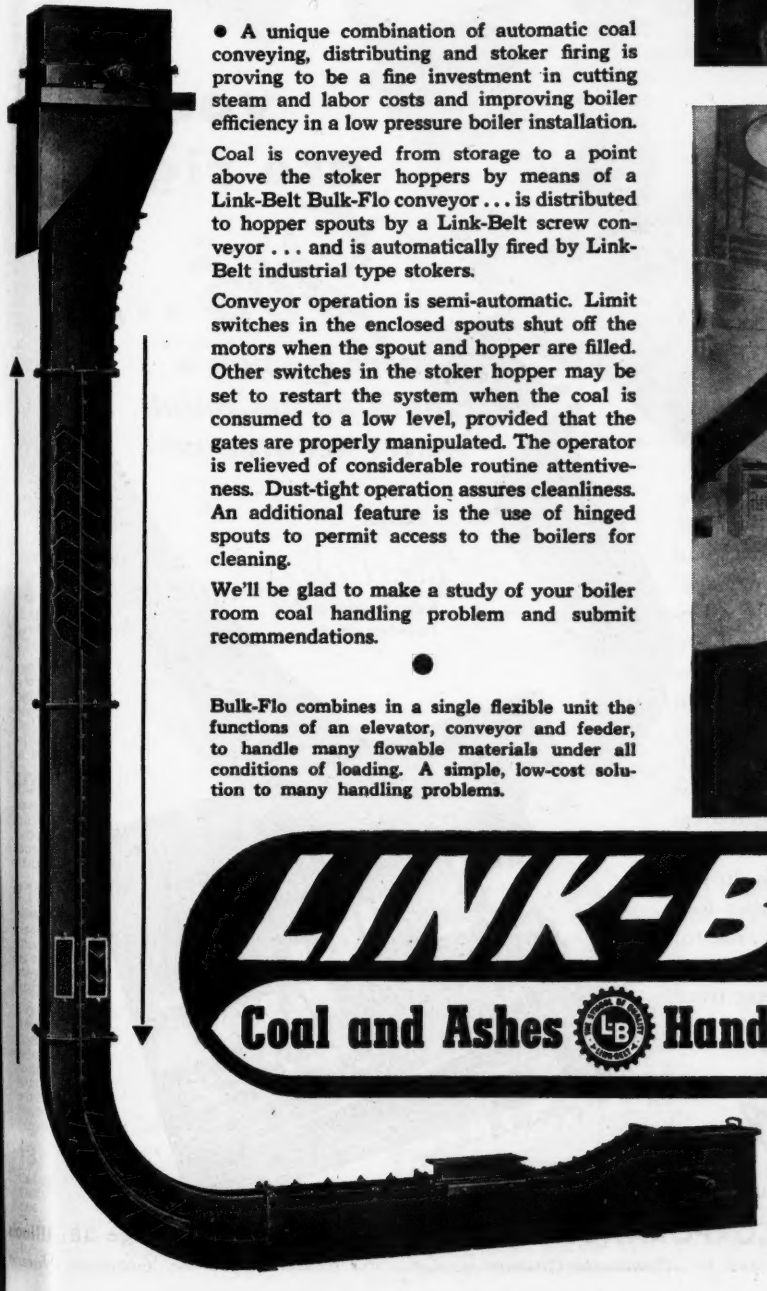


AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES: BOSTON • PHILADELPHIA
CLEVELAND • DETROIT

Bulk-Flo... Screw Conveyor... Stoker Combination ↓ CUTS STEAM COST







• A unique combination of automatic coal conveying, distributing and stoker firing is proving to be a fine investment in cutting steam and labor costs and improving boiler efficiency in a low pressure boiler installation.

Coal is conveyed from storage to a point above the stoker hoppers by means of a Link-Belt Bulk-Flo conveyor . . . is distributed to hopper spouts by a Link-Belt screw conveyor . . . and is automatically fired by Link-Belt industrial type stokers.

Conveyor operation is semi-automatic. Limit switches in the enclosed spouts shut off the motors when the spout and hopper are filled. Other switches in the stoker hopper may be set to restart the system when the coal is consumed to a low level, provided that the gates are properly manipulated. The operator is relieved of considerable routine attentiveness. Dust-tight operation assures cleanliness. An additional feature is the use of hinged spouts to permit access to the boilers for cleaning.

We'll be glad to make a study of your boiler room coal handling problem and submit recommendations.

●

Bulk-Flo combines in a single flexible unit the functions of an elevator, conveyor and feeder, to handle many flowable materials under all conditions of loading. A simple, low-cost solution to many handling problems.

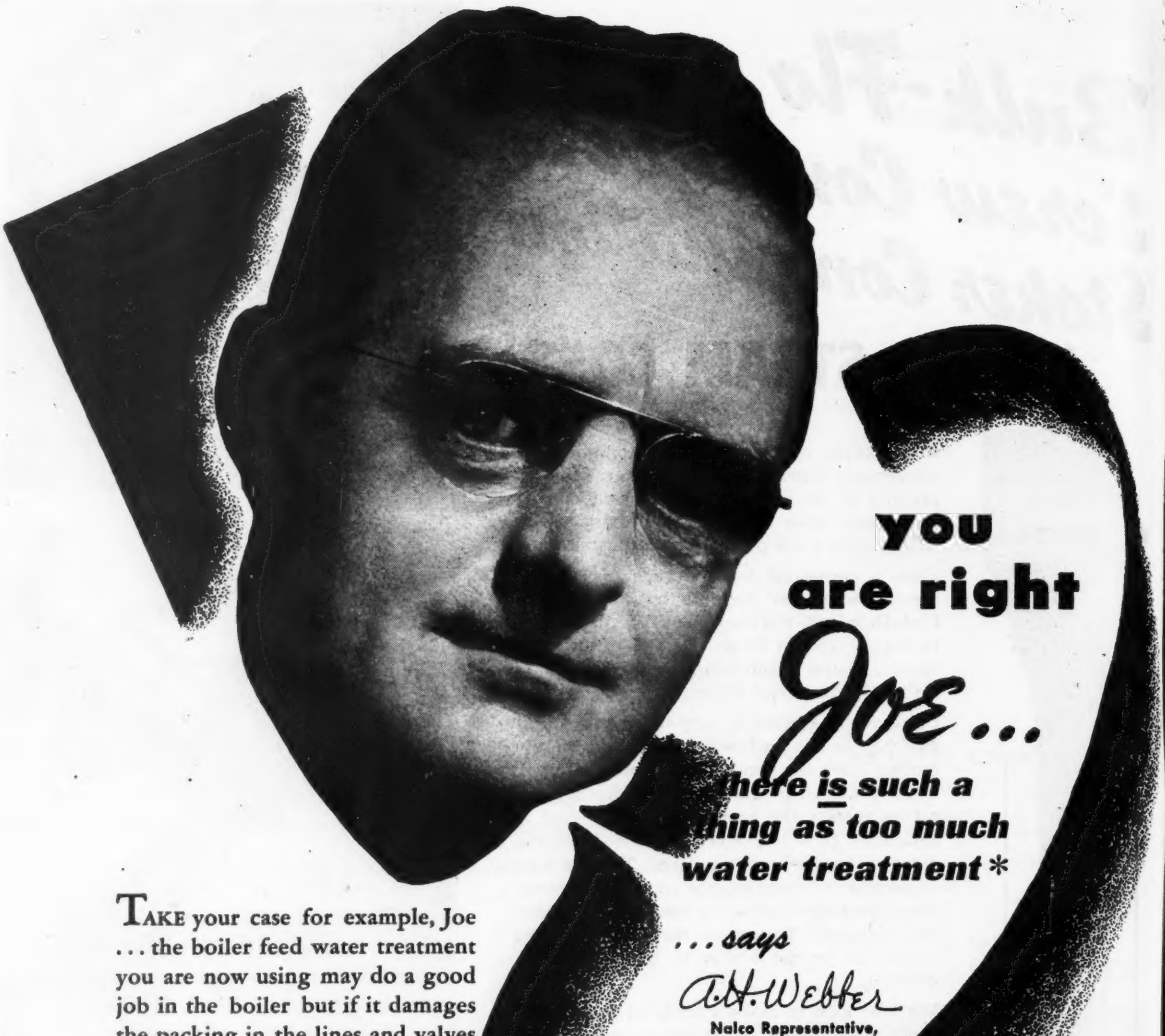
8801

LINK-BELT

Coal and Ashes Handling Equipment

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in principal cities.



you are right Joe...

there is such a thing as too much water treatment*

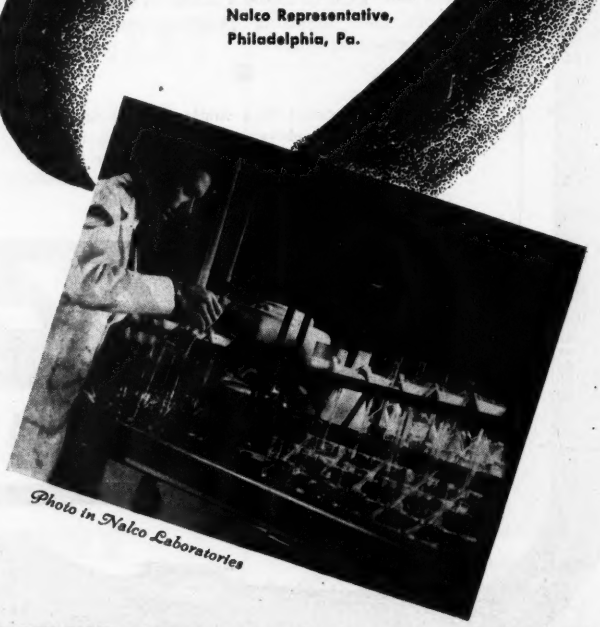
...says

A. H. Webber

Nalco Representative,
Philadelphia, Pa.

TAKE your case for example, Joe ... the boiler feed water treatment you are now using may do a good job in the boiler but if it damages the packing in the lines and valves —*you may be overtreating the water.* A Nalco survey could determine the *exact* kind of treatment best suited to your plant conditions ... and would eliminate the possibilities of *hit or miss* treatment that accomplishes one thing at the expense of another.

For top plant efficiency do not *under-treat* or *over-treat* boiler feed water. Your first step? ... ask for a Nalco survey. Learn about Nalco, the system of *scientific* water treating. There is no obligation.



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SYSTEM OF SCIENTIFIC WATER TREATING
SERVICE ... FOR ALL INDUSTRY

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Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Ram Feed Stoker**—Bulletin 400 describes the Lo-set stoker, one of Canton's 54 types and sizes for needs up to 800 hp. Ruggedly constructed to meet severe service demands with trouble-free performance . . . backed by five year guarantee. Canton Stoker Corp.

2 **Pneumatic Ash Handling System**—The economical, labor-saving "Vac-Veyor" which conveys and delivers the ashes to the silo in a completely dry condition is described in a bulletin. Beaumont Birch Co.

3 **Underfeed Stokers**—The unit type electro-hydraulic drive and other features which help assure even fuel distribution and perfect combustion in Flynn & Emrich underfeed stokers are described in Bulletin 1105. Flynn & Emrich.

4 **No-Vent Boiler Return**—Bulletin explains how Stout no-vent boiler return system runs continuously, collects condensate as fast as formed, saves fuel. Also shows guarantee chart. David Stout & Sons.

5 **Tube Cleaner Data**—A new 4-pg Bulletin Y-19, on the Lagonda type 1300 series tube cleaner, emphasizes the improved lubrication system for these machines. A cutaway view of the motor, an exploded view of its simple assembly, and an illustration of its operation in curved tubes feature the inside spread of this bulletin.

6 **Spreader Stokers**—Bulletin No. 78 describes the Fyr-Feeder multiple spreader type stoker under the theme "burns coal like oil." The principle of the multiple spreader stoker is included with detailed illustrations and installation data. American Coal Burner Co.

7 **Air Cleaner for Fly-Ash**—"Newsfront," a new 4-pg monthly publication by the Westinghouse Electric and Manufacturing Co. describes the latest achievements by the Company. Featured in the first issue is a story on a new application of the Precipitron air-cleaner for the removal of fly-ash, and a picture page illustrating recent Westinghouse developments.

ELECTRICAL

8 **Condensed Motor Catalog**—New 16-pg Catalog GEA-4281 gives ratings, sizes, characteristics, dimensions, where-to-use data and prices of GE AC and DC motors, 1/16 to 75 hp. General Electric Co.

9 **Data Book On Fluorescent Lighting**—Number one in a series of know-how lighting booklets deals with the Fluorescent lamp—what it is and how it operates. Contains many helpful diagrams and equipment photos. Westinghouse Electric & Mfg. Co.

10 **Electrical Rust Preventive**—Bulletin describes method which maintains the tank in an "electro-negative" or neutralized state, prevents rusting—gradually removes the product of any earlier rusting. Rusta Restor Div., The Johnston & Jennings Co.

11 **Low Speed Synchronous Motors**—Compactness, accessibility, good line power factor and other advantages of Elliott synchronous motors, operating at speeds of 450 rpm and below, are covered in new file size bulletin. Also gives detailed views of major construction features. Elliott Co.

12 **Terminal Blocks for Control Wiring**—New booklet describes 10 styles of Controlead terminal blocks, originally developed for central station and sub station control cable connections, and now widely used as junction points in any control wiring installation. Booket lists operating features, applications, cross-section views, dimensions and prices. Burke Electric Co.

13 **How Cathode Tubes Work**—New 16-pg illustrated booklet on "How & Why Cathode Ray Tubes Work," including a discussion of complete television set-ups, has been announced by North American Philips Co. Covers early history, mathematical concepts, present-day problems, tube testing. Schematic diagrams help to convey the idea of how the tube functions.

FANS, PUMPS, COMPRESSORS

14 **Facts About Rotary Pumps**—Bulletin No. 304 pictures operating cycle, buckets, rotor and other features of Blackmer rotary pumps. Also shows single unit, twin unit, V-belt and various pump types; contains capacity curve and other useful data. Blackmer Pump Co.

15 **Ventilating and Duct Fans**—Condensed bulletin describes the new Wingfoil fan wheel, the Wingfoil straight line duct fan, and the Wingfoil elbow type duct fan. "Duct fan" is a new designation for what was formerly called an "Exhauster." Capacity tables, dimensions and engineering data make this a particularly valuable bulletin for the engineer. L. J. Wing Mfg. Co.

16 **Positive Displacement Blowers**—Operation and construction features of Pottsdown rotary positive displacement type blowers and exhausters are described in a new 16-pg bulletin issued by Allen Billmyre Co. Unit is designed for services where volume of air or gas discharged must remain constant under variations in pressure or vacuum. Included are tables of capacity for both blowers and exhausters, and technical data helpful in the selection of a suitable unit.

17 **Pump Equipment**—Bulletin No. WP-1099-B37B describes Worthington equipment, including pumps, ejectors, diesel and gas engines, air and gas compressors, air tools, steam turbines, turbine generators, deaerators and deaerating feedwater heaters, etc. Worthington Pump & Machinery Corp.

18 **Pumps In the War**—Attractively illustrated 20-pg booklet, "Warren Pumps Went to War," tells of part this equipment is playing on various types of fighting craft. Types pictured include main boiler feed, circulating, cargo oil, fire and general service pumps. Warren Steam Pump Co.

HEATING EQUIPMENT

19 **Heat Transfer Equipment**—New Bulletin No. 645 describes Whitlock heat transfer equipment, including shell and tube and coil types. The bulletin illustrates design considerations pertinent to the chemical processing field, such as tube bundle and closure construction; specifies individual product data including fuel oil heaters, water heaters, and power plant equipment. The Whitlock Mfg. Co.

20 **Storage Water Heaters**—Bulletin 35-75P furnishes information on the Adsco line of storage and instantaneous water heaters, heat economizers and special equipment. American District Steam Co.

21 **Direct-Contact Open Heater**—Bulletin 4091 on open feed water heaters describes different types of tray heaters for various applications, the jet heater, V-notch metering heater, convertible tray type of heater. Illustrations show various combinations of heaters with storage tanks and should be of interest to engineers interested in heating water for boiler feed or process requirements. Cochrane Corp.

22 **Air-Cooled Heat Exchanger**—How the new Alco air-cooled heat exchanger provides efficient cooling without water is explained in Bulletin No. 1035. Applications include jacket water for Diesel and gas engines, lubricating oil cooling, cooling gears, steam condensing, gas cooling and vapor condensing. American Locomotive Co. (Alco Products Div.)

23 **Radiant Heating Handbook**—How to calculate, design and install radiant heating systems for buildings is described in the new 52-pg handbook, "Byers Wrought Iron for Radiant Heating," just issued by A. M. Byers Co. Procedure is listed for figuring heat losses and piping requirements, designing the coils, supply and return mains. Factual data is presented on the relative merits of locating the coils in floor and ceiling.

24 **New Line of Heating Coils**—To meet the more specialized requirements of extended surface heating coils in modern air conditioning, heating, drying and processing systems, the Modine Manufacturing Co. has introduced a new line of copper blast heaters and booster units. Modine coil design features all-copper and copper alloy condensers, scientifically dieformed fins which are permanently bonded to tubes by metal, pressure-resisting brazed construction of steam carrying passages. Modine catalog 345 contains complete descriptive and engineering data.

INSTRUMENTS AND CONTROLS

25 **Mechanical Flow Meter**—Bulletin 318B tells about the Builders Flowatch recording and totalizing meter for liquids, steam, air and gas. Diagrams show recommended meter hookups under various plant flow conditions. Builders-Providence, Inc.

26 **New Electric Timer**—A new electric timer Bulletin No. 1100, has been released by the C. H. Stoelting Co., Industrial Div. Describes stop clocks, precision chronoscopes, combination timers and impulse counters, stop watch controllers, and spring wound X-ray timers. These Stoelting timers have wide application in measuring start-to-stop intervals of relays and instruments and for checking sequence operations. Circuit diagrams are included to show correct methods of connecting the various timers in test circuits.

27 **Electrical Test Equipment**—The accuracy of laboratory circuits and techniques, reduced to simplest terms for lay operation in everyday industry, are discussed in the "Electrical Test Instruments" bulletin released by Industrial Instruments, Inc. Featured are: direct-indicating comparison bridge, capacity and resistance limit bridges, resistance and capacitance decades, Wheatstone bridge, voltage breakdown testers and test fixtures, Kelvin bridge, megohm bridge and megohm meter, and conductivity apparatus.

28 **Controls for Machine Tools**—New GEA Bulletin 4254 describes construction and applications of GE push-button units, selector switches, indicating lights. Many diagrams give approximate dimensions and other useful data. General Electric Co.

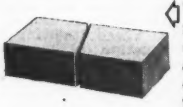
Coupon must be filled in completely to secure literature your request. Pasting coupon on penny postcard saves time and money.

FASTER CUTTING
...with
Clipper Masonry Saws

Your Special Size and Shape Brick or Tile can now be "Tailor-Made" at a moment's notice!

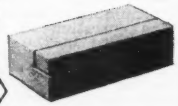
The new Clipper Multiple Cutting Principle makes possible faster cutting of every masonry material regardless of hardness.

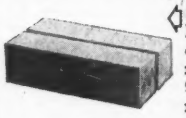
Here are a few typical examples of the speed and accuracy with which fire brick can be cut for furnace repairs.



This acid brick intended for a chemical plant acid chamber was cut completely in two, in 37 sec.

One of many intricate cuts performed on first quality clay brick for heat treating furnaces. Made in 8 seconds.





Silica brick cut lengthwise for open hearth furnace work, only 9 seconds were required to complete this cut!

Basic refractories for steel furnaces or cement kilns must be accurately installed.

29 **Regulator Data**—Catalog 70 contains eight sections of useful engineering data on reducing valves, temperature regulators, pump governors, liquid level controllers, float valves, and sirens. Foster Engineering Co.

30 **Remote Mechanical Control**—M. L. Bayard and Co. announces a new manual describing in detail standard related units of a remote mechanical control system. Specification and capacity charts are given for the universal shaft assembly, steady shaft assembly, and bevel gear assemblies. In addition, are details on layouts for the most effective arrangement of these standard integrated units for such uses as to open or close large valves, ventilators, banks of windows, or in conjunction with such equipment as cranes, windlasses, winches and steering gear.

31 **Load Ratio Control**—A voltage regulator for use on power transformers to change taps without interrupting the load and to keep line voltage at proper level is presented in a new bulletin on load ratio control by the Allis-Chalmers Mfg. Co. Methods of interrupting current under load and the equipment used—large dial switches for changing taps and controlling voltages, driving mechanisms used for operating switches and circuit breakers, and Allis-Chalmers' automatic "feather-touch" control—are discussed.

31A **Recording Gravitometer**—Its sensitivity to all changes of specific gravity and other features of the AC-ME recording gravitometer for insuring the correct measurement of gas are described in Bulletin No. 30. The Refinery Supply Co.

PIPING, VALVES, FITTINGS

32 **Remote Control Valves**—Bulletin 800 describes the Grove Flexflo remote control valve for any fluid handling service such as oil, water, salt water, chemical solutions, gases and air. Just one more metallic moving part operates to open and close valve. Grove Regulator Co.

33 **Flexible Metal Hose Handbook**—A new engineering data file on the installation of flexible metal hose, has been issued by Packless Metal Products Corp. Over sixty pages of photographs, specifications and line drawings show the correct installation practices. Sections show photographically how to assemble detachable self-sealing hose couplings and self-flaring fittings for copper and plastic tubing right at the job.

34 **Pipe Joint Compound In Stick Form**—Folder describes Pipetite-Stik, pipe joint compound in handy clean, easy-to-use stick form. All that is necessary is to rub 3 or 4 strokes of stick across pipe threads. It spreads and fills threads when turned. Encased in a convenient cardboard holder the stick may be carried around in a pocket or tool kit, always ready for instant use. Said to be unaffected by air, water, steam, acid, gas, brine, etc. Lubricates and seals pipe joint threads, nuts, bolts, gaskets, turn-buckles, etc. Prevents rusting. Lake Chemical Co.

35 **Fluid Handling Products**—A new, informative catalog, No. 45, on Fluid Handling Equipment for industrial installations features a complete line of Zurn suction and pressure line strainers, such as duplex vertical chamber type strainers, "Y" strainers, and angle type strainers and remote valve control assemblies. Other products described are interceptors for grease, wax, fats, oils and solids. J. A. Zurn Mfg. Co.

36 **Condenser Tube Protection**—Flowrites, short belled-end metal inserts which protect condenser tube inlets against erosion, are described in a new bulletin released by Condenser Service & Engineering Co., Inc. Tests show that Flowrites, because of their peculiar shape, create a

SERVIRON
Protects Boiler and Tank Interiors Against
RUST and FUNGI

Odorless

Tasteless

Serviron is an odorless, tasteless, permanently viscous material. It protects metal against corrosion, and prevents deterioration and fungus growths on wood, concrete or metal, submerged in water, brines and certain acids and caustics. Serviron is used extensively in boilers, laundries and refrigeration plants. It is unaffected by feed water treatment, and is used with equal success in hard and soft water. Serviron is ideal for drinking water tanks.

Easy to Apply—

Serviron may be applied to any clean, dry surface with a stiff brush, and spread until a very thin coat remains. The applicator can work comfortably in cramped quarters because no obnoxious odors or gases are emitted.

Sticks Tightly—

Unlike paint, Serviron does not dry. It bonds so firmly, that it cannot be loosened.

Use Indoors or Outdoors—

Serviron may be used in hot or cold water tanks, indoors or outdoors. Since it remains viscous within a wide temperature range, it expands and contracts with the surface, eliminating the danger of hairline cracks.

Economical—

One gallon of Serviron goes a long way. A single, thin coat does the entire job. No primer is required. Its long-lasting, protective qualities reduce maintenance, and assure clean, tasteless, rust-free water. Order a trial quantity.

XZIT SALES CO.

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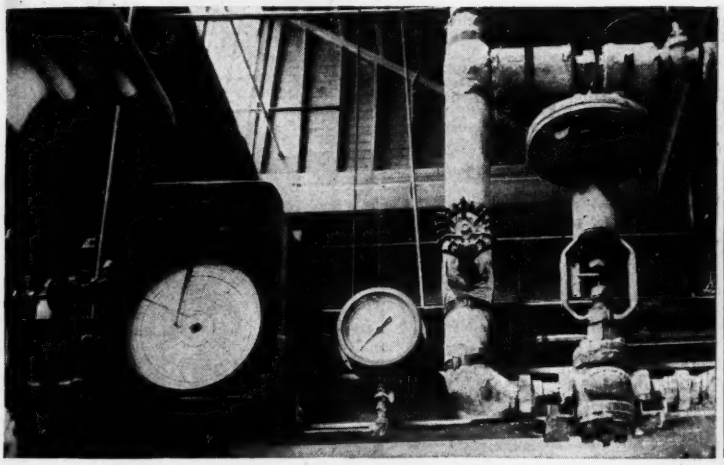
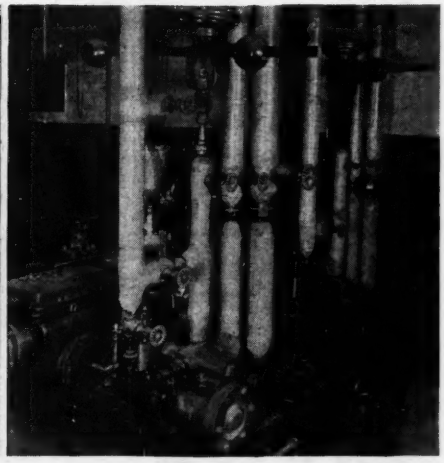
How to Have *Trouble-Free* PRECISION CONTROL

of every operation or process



★ One of the McAlear No. 110 Diaphragm Motor Valves controlling saturated steam pressure to wire rubber-processing machines in plant of leading manufacturer of wire and cable.

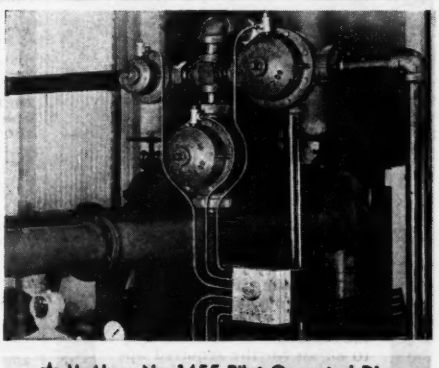


★ McAlear No. 455 Pump Governor regulating speed of steam vacuum pump on condensate return lines of large Government housing project.

DEPENDABLE, long-life, high precision, low maintenance control instruments for more than 500 specific applications in power and process industries have been developed by McAlear.

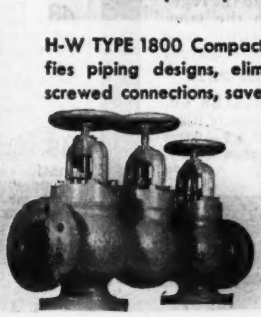
For *every* application that involves exacting control or regulation of temperature, flow, level or pressure of steam, water, air, gas, chemicals or oil—*McAlear either has the control you need*—or will develop it for you.

If *you* have a control problem call on McAlear engineers. Draw on their fund of experience . . . on their readiness and willingness to help you. For informative bulletins or catalog, write McAlear Manufacturing Company, 1915 S. Western Avenue, Chicago 8. *Affiliated with Hanlon-Waters, Tulsa, Oklahoma: Climax Engineering Company, Clinton, Iowa.*



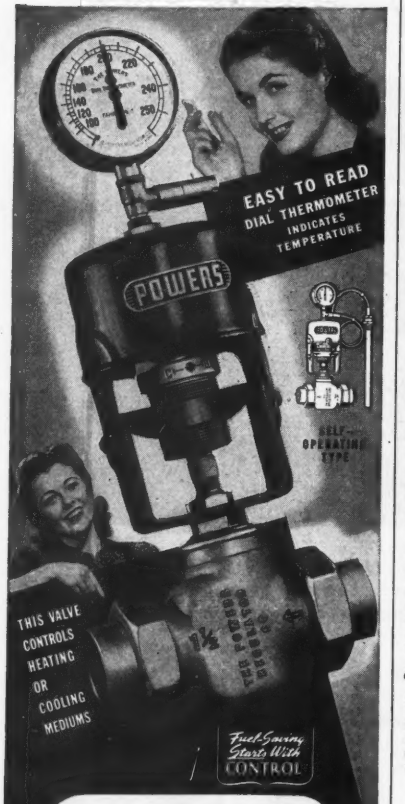
★ McAlear No. 1455 Pilot Operated Diaphragm Valves controlling flow of hard-to-handle liquid in processing operation.

H-W TYPE 1800 Compact By-Pass Manifold simplifies piping designs, eliminates many flanged or screwed connections, saves space, reduces leakage hazards, without increasing installation costs. Sizes ½ to 4 inches. Bronze, cast iron, steel, screwed, flanged, silver braze and steel socket weld ends. Write for bulletin No. 117.



Economize WITH POWERS

TEMPERATURE REGULATORS



Use a Powers No. 11 Temperature Indicating Regulator when you want the advantages of an easy-to-read dial thermometer combined with a dependable self-operating regulator. The dial thermometer gives a visual check on the performance of the regulator and makes it easy to adjust for the required operating temperature. Various dials and ranges are available.

Is Easy To Install—because both the thermometer and the regulator operate from the same thermal system—only one tapped opening is required.

Write for Circular 2511

THE POWERS REGULATOR CO.

2746 Greenview Avenue, Chicago 14, Illinois
231 E. 46th St., New York 17, N. Y.—Offices In 47 Cities . . . See your phone directory.

70

OVER 50 YEARS
OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

38 Steam Condensation Unit.—Descriptive bulletin tells how new design of Dawes condenser saves space and weight, doubles capacity of conventional smooth-tubed units. Capacity up to 10,000 lbs. of steam per hr. Contract Engineer Co.

39 Diesels for Central Stations.—A line of 4-cycle Diesels incorporating design and construction features to lower operating and maintenance costs—prolong engine life. Write for complete data on the Hendy Series 50 Diesel engine. Joshua Hendy Div., Joshua Hendy Iron Works.

40 Steam Power Plant Planning Guide—Information on 10,000 to 60,000 kw. condensing turbines, surface condensers and auxiliaries, is presented in the new Steam Power Plant Planning Guide announced by Westinghouse Electric and Mfg. Co. Part I of the 40-pg. booklet illustrates types of turbines, and charts turbine sizes and speeds. Part 2 on Performance Data covers basic operating conditions, including effect of deviation in pressures and temperatures on heat rates; regenerative feed-water heating; recommended condenser sizes, and condenser dimensions; condenser friction; impeller, propeller and axial type circulating pumps; and condensate pumps.

41 Diesel Operation—Fully illustrated 112 pg. handbook "Diesel Operation" show relation of fuel and lubricants to operating efficiency of Diesel engines. A useful reference for all power plant men. The Texas Co.

WATER TREATMENT

42 Chemicals for Water Analyses—New 44-pg booklet presents various apparatus and chemicals used for Industrial Water Analyses for plant control. Features test sets required for such determinations as hardness, alkalinity phosphate, sulfate, dissolved oxygen, pH value, silica, and others. Comparators, photometers, turbidimeters also are displayed. W. H. and L. D. Betz.

43 Studies of Boiler Scale—"Experimental Studies of Boiler Scale at 800 psi" is the title of a reprinted article covering tests of boiler feedwater treated with calcium, magnesium, silica, alumina, phosphate. Photos show deposits under various operating conditions. National Aluminate Corp.

44 Boiler Blowdown Equipment—"Complete Automatic Control of Boiler Water Concentration without Heat Loss" is the title of a bulletin describing Henszey continuous blowdown equipment—complete, automatic control of boiler water concentration without heat loss. Henszey Co.

45 Removal of Ammonia from Boiler Feed Water—Cochrane Corp. has for distribution Reprint 39, which discusses briefly the removal of ammonia from boiler feed water. This discussion takes into account three practical methods, such as use of a deammoniator, the use of chlorine and the use of an acid-regenerated zeolite.

MISCELLANEOUS

46 Waterproofing and Leak Sealing Compound—Booklet describes compound that seals leaks against water pressure—waterproofs walls—seals concrete water tanks or vats. Comes in liquid form and, when added to concrete mortar, sets up quickly—protects against dampness and underground seepage. Flexrock Co.

47 Acid-Proof Brick Floors—Attractively illustrated 16-pg bulletin sets forth characteristics and advantages of Belden acid-proof floor brick. Will not burn, soften, rot, or deteriorate under traffic; widely used in dairies, foundries, meat packing and food plants, machine shops, etc. The Belden Brick Co.

48 Fire Prevention Handbook—New 36-pg booklet "Fire and How to Fight It" describes various types of electrical, flammable liquid, and ordinary fires; gives simple rules for extinguishing them. Also tells about latest fire extinguisher equipment. A valuable handbook for engineers and maintenance men in power plants and factories. Walter Kidde & Co.

49 Automatic Tube-Ice Machine—Operation and advantages of Vogt automatic tube-ice machine are described in 16-pg bulletin. Diagram in color shows how machine works. Applications in milk and packing plants, hotels, chemical plants, etc. are pictured. Henry Vogt Machine Co.

50 Spiral Wound Gasket Data—Revised catalog gives complete data, specifications on the Ajax line of spiral wound metal and asbestos gaskets. Made for pressures from 10 to 3500 psi. U. S. Gasket Co.

Your Blueprint for

MORE POWER

starts with

OAKITE CLEANING

Controlling Slime In Air Conditioning Equipment . . . . . .

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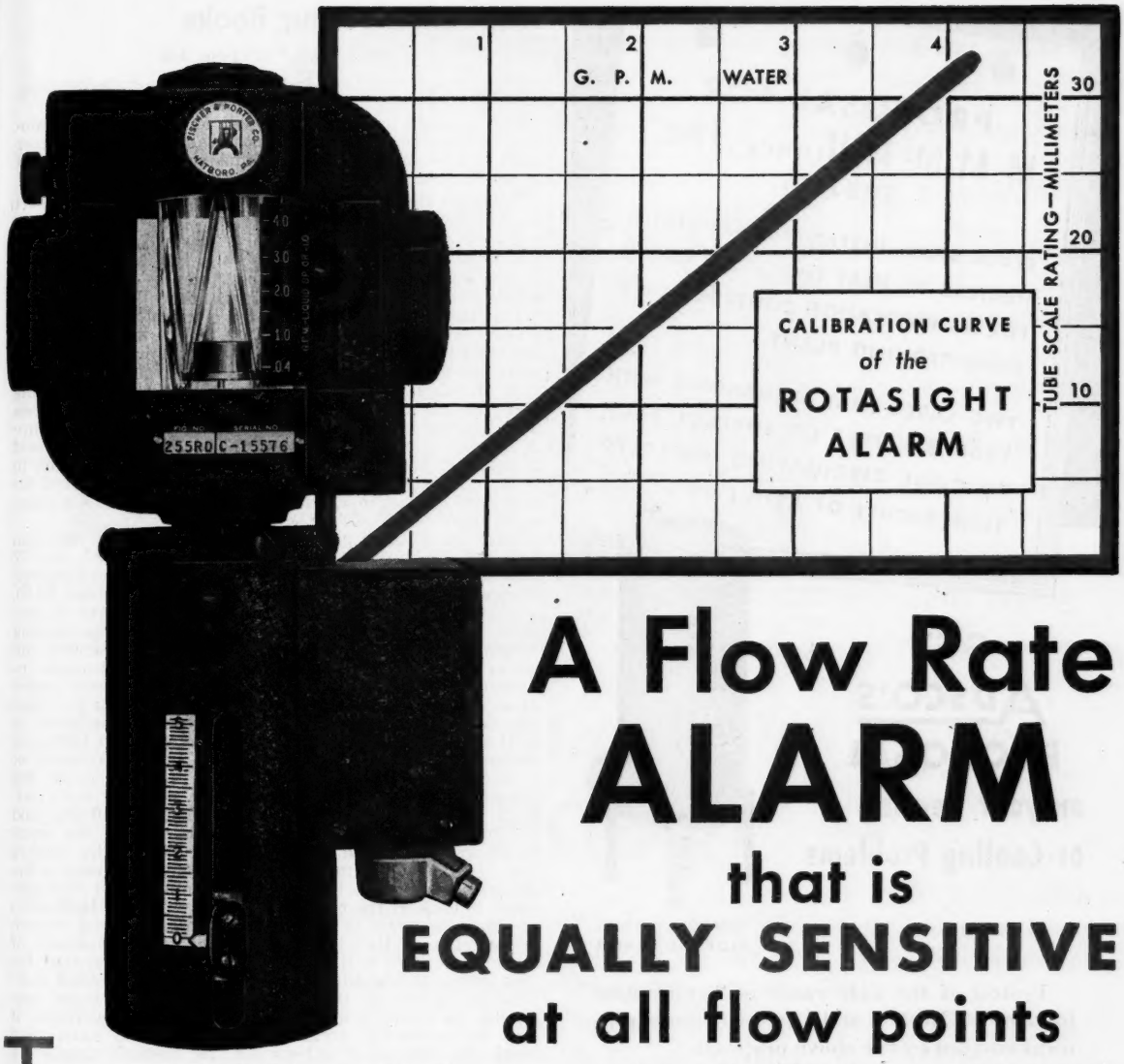

A Flow Rate ALARM that is EQUALLY SENSITIVE at all flow points

THE ROTASIGHT ALARM is an excellent flow rate alarm because the float, which actuates the alarm, responds to flow rate changes only. When we add, however, that the float reacts to flow changes with the same high sensitivity at all points in the flow range, it seems to justify the statement that the Rotasight Alarm is a *remarkable* flow rate protective device. The straight-line calibration curve, shown above, is typical of the Rotasight and proves that the float moves the same distance for a given flow increment at all points in the flow range, whether high or low. The result is a Flow Alarm that is positive and accurate at the exact flow rate where you desire protection.

The Rotasight is an area-type flow meter in which the float moves up and down in a precision-bore transparent metering tube fashioned with unique V-ported flutes. All of the flow goes through the meter and the float trips an external magnetic switch at the alarm point. The external switch is adjustable easily and quickly to any point over the entire flow range of the instrument.

The Rotasight is cast in iron and bronze in sizes from ¼" to 2½" inclusive. It will handle minimum flows of 0.03 G.P.M. of liquid and 0.06 C.F.M. of gas, and maximum flows of 60 G.P.M. of liquid and 135 C.F.M. of gas. Larger flows up to 14,000 G.P.M. liquid or 16,000 C.F.M. gas may be metered in our Rotasleeve Alarm.

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The Rotasight Alarm may be equipped with explosion-proof switch housing for hazardous locations.

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ADSCO VERTICAL
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ADSCO equipment is built just right for your job—with the capacity and reserve requirements necessary for most efficient operation. Put your heat exchange problem up to us or write for Bulletin Number 35-75 E.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA NEW YORK
Makers of UP-TO-DATE Steam Line Equipment For Over 65 Years

New Engineering Books

(Continued from page 184)

cluding chapters on instruments follow gas conditioning, hydraulic equipment and high pressure equipment.

Power engineers in general will find this book invaluable as a reference and we think that a copy of it together with a copy of the author's Industrial Chemistry ought to be on every engineer's bookshelf.—C. R. E.

Practical Design for Arc Welding, Volume 2. By Robert E. Kinkead; copyright 1944; 8¾ by 11½ in.; 107 pages; hard cloth binding; published by The Hobart Brothers Co., Hobart Square, Troy 1, Ohio. Price $3.50.

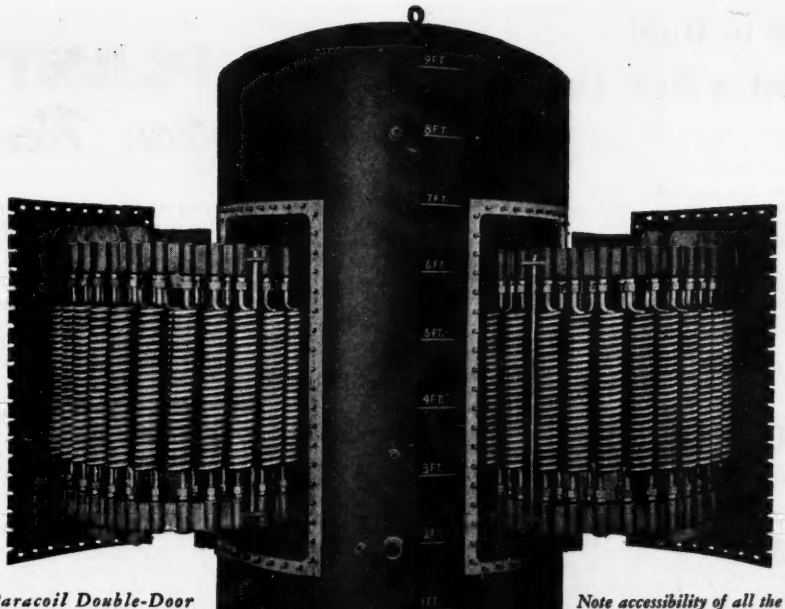
This book is a continuation of Volume 1 and gives 100 additional welding plates. The author calls these plates "idea stimulators" intended for the use of designers, engineers and fabricators who are interested in making the most of welding now on hand or to be installed. Considerable attention is paid in this volume to the fabrication of tubular members and connections, thus making many of the ideas applicable to both piping installations and tubular structural design. Each plate is a picture of a welding job to be done with the indicated work told in symbols, accompanied by a record form upon which to record the cost of the job, and graph space provided for free-hand visuals of the proposed design. This is a practical man's handbook without theory.

Conference Leader Training. By Edward S. Machlin and Paul T. McHenry; copyright 1945; 5½ by 8¼ in.; 77 pages; semihard cloth binding; published by the National Foremen's Institute, Inc., Deep River, Conn. Price $2.50.

This book, or manual as the authors designate it, presents in a concise form the needs for leadership training with the object of developing an interest in learning the underlying principles of conference leading through individual study and by observing the experienced leader at work. They also present in a practical form the various devices used in dealing with different situations, as well as the techniques involved in planning and leading a discussion. Stress is laid on the fact that the director of a conference must be able to plan, lead and direct the thinking of a group. The book also presents some criteria for judging the quality of the leader's efforts, and for making criticisms and commendations of the work of others. "The goal of leadership training," the authors say, "is the establishment of a conference program in the department of each trainee. This implies that management is back of the entire procedure from the leadership preparation down to the holding of conferences in each department of their organization. The development of such a program will be assigned to those prepared for this work, it should not be trusted to untrained individuals." Although the book is intended for those preparing to direct a conference of industrial workers, it will be extremely useful to any man who must plan work for himself or others for the manual suggests a course of thinking that is logical and aimed at getting things done efficiently and with dispatch.

Air Compressors. By Eugene W. F. Feller; copyright 1944; 5 by 8½ in.; 460 pages; hard cloth binding; McGraw-Hill Book Co., New York, N. Y. Price $4.50.

Since this book is intended principally for operating engineers and mechanical engineering students interested in air compressors and compressed air application, the author has gone deeply into the details of construction and has filled the pages full of helpful illustrations. This feature is very helpful in familiarizing the reader with all types of compressors now commonly used in industry. Installation, operation and maintenance information is presented in detail, with special emphasis on engineering practices that generally are known only to those working in the three separate branches. The book is divided into fourteen different chapters which deal not only with all types of compressors but with accessories, installation and maintenance problems, lubrication and a chapter on the theory of compressing air. The presentation of many curves, tables and diagrams makes the book extremely useful as an operator's guide. Every element of construction is treated in detail, factors entering into the selection of air-compressor drives are discussed at some length, various methods of controlling pressures and speeds are adequately treated, a separate chapter is devoted to each of the following types of compressors: rotary, centrifugal, axial flow, and an explanation of hydraulic compression of air. The book is not only interesting reading but contains highly valuable reference material.



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Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in sizes for wide range of capacities.

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POWER PLANT *Construction News*

Calif., Los Angeles—Southern California Edison Co., 801 West Fifth St., Los Angeles, will begin work soon on new 220,000-volt steel tower transmission line from Boulder Dam hydroelectric power development of Government to points in San Bernardino and Riverside Counties. A large power substation, to be known as Highgrove, will be built at line terminus in last noted area, to be used for power distribution to Riverside, Redlands, San Bernardino and other communities. Project has a priority rating and is estimated to cost about $4,500,000.

Calif., Modesto—Floden Brothers, 1325 Ninth St., food products, plan installation of electric power equipment in new one-story poultry processing and packing plant. A cold storage and refrigerating plant will be installed. Cost estimated about $60,000. Application has been made for a priority rating. G. N. Hilburn, 1211 K St., Modesto, is architect.

Fla., Pensacola—Bureau of Aeronautics, Navy Department, Washington, D. C., is arranging appropriation of $959,000 in Federal budget for coming fiscal year, dating from July 1, for modernization and extensions in central power plant at naval air station, Pensacola, including installation of additional equipment for increased capacity. Also will install new conditioning equipment for boiler feed-water and heating apparatus, to cost about $100,000. Extensions and improvements will be made in electrical distribution system to cost approximately $100,000. Work will be carried out under direction of Bureau of Yards and Docks, Navy Department, Washington.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., has plans under way for expansion in Calumet power plant, East 100th St. and Calumet River, including addition to station and installation of additional equipment to increase output by 107,000-kw, comprising turbine-generator unit and accessories, high-pressure boilers and auxiliaries, switchyard extensions and other work. Cost reported about $12,000,000. Priority rating has been secured. Completion is scheduled late in 1946. Sargent & Lundy, 140 South Dearborn St., Chicago, are consulting engineers.

Ill., Havana—Illinois Power Co., Decatur, Ill., has plans maturing for new steam-electric generating station at Havana, where site has been secured fronting on Illinois River. It will have an initial capacity of 80,000-kw, divided into two 40,000-kw units, with high-pressure boilers and auxiliary equipment, and is reported to cost approximately $5,000,000. A priority rating has been granted and work on foundations will begin soon. Plant completion is scheduled in 1947. Project will include new transmission lines for connection with present high-tension system.

Ind., East Chicago—Continental Foundry & Machine Co., manufacturer of castings, rolls, etc., plans installation of electric power equipment in new addition to plant for expansion in machine shop. Cost reported close to $100,000, with machinery. Project has a priority rating and work will begin soon.

Iowa, Clinton—Interstate Power Co., Dubuque, Iowa, has approved plans for expansion in steam-electric generating plant at Clinton, with installation of new 15,000-kw turbine-generator unit, boiler and auxiliary equipment. Project has a priority rating and work on superstructure will be placed under way at early date. Cost reported close to $2,000,000. Extensions will be made in transmission lines. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Kans., Abilene—Kansas Power & Light Co., Topeka, Kans., has plans for expansion in steam-electric power plant at Abilene, with installation of additional equipment for increased rating. Cost reported about $500,000. Proposed to begin work at early date. A priority rating is being secured. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Mo., Independence—Municipal Light Department is considering expansion and improvements in municipal power station as a postwar project, with installation of new turbine-generator unit, boiler and auxiliary equipment for replacement of present units and increased capacity. Cost estimated close to $300,000.

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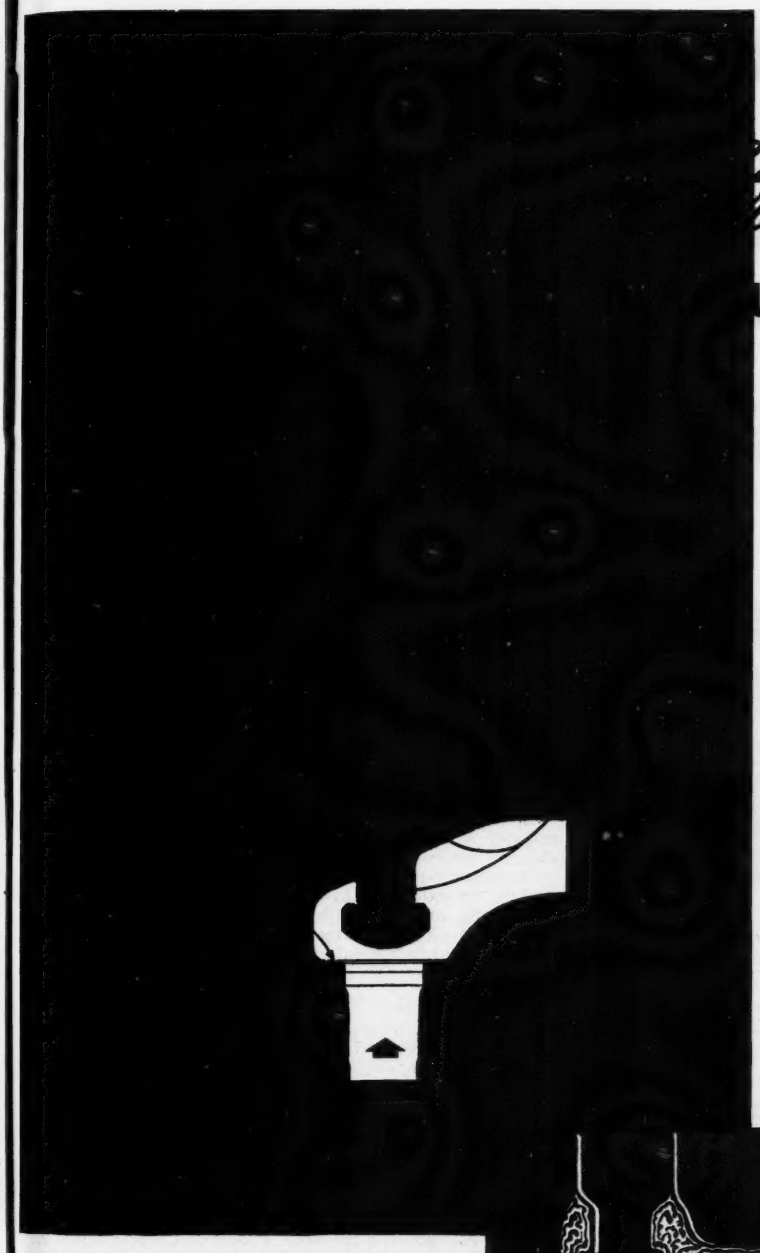
● Typical of SK leadership in valve engineering is the newly developed streamline valve body which reduces pressure loss to a minimum. A separate alloy cylinder having a hard-surfaced bushing is provided in the valve body to guide the disc assembly at two points assuring proper alignment, even seating and positive trouble-free operation. The double-welded seat ring includes a special isolated seal weld which eliminates possibility of distortion of the seat face.

Consult Schutte & Koerting about special high pressure valves or write for information on Boiler Non-Return Valves and Check Valves (Bulletin No. 8-B), Pressure Reducing Valves (Bulletin No. 8-R), and Turbine Valves (Bulletin No. 8).



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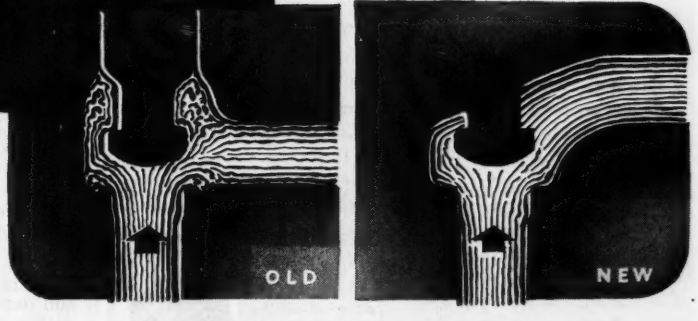

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N. H., Portsmouth—Bureau of Ships, Navy Department, Washington, D. C., will have plans prepared soon for extensions and improvements in power plant at navy yard, Portsmouth, with installation of additional equipment for increased output. Also will make extensions in electrical distribution system. Fund of $400,000 is being arranged in budget for Federal fiscal year, dating from July 1. Bureau of Yards and Docks, Navy Department, Washington, will be in charge.

N. Y., Staten Island—Staten Island Edison Co., 50 Bay St., St. George, S. I., has acquired tract of land on Victory Blvd., Travis, and will use as site for large power substation, for which plans will be prepared at early date. Cost reported over $3,500,000, with transmission line extensions and other operating facilities. Project, it is understood, will be carried out as a postwar development.

N. D., Washburn—Otter Tail Power Co., Fergus Falls, Minn., has approved plans for expansion in steam division at generating station at Washburn, with installation of new boiler unit and auxiliary equipment. Cost estimated about $250,000. Project is understood to have a priority rating and work will begin soon.

Ohio, Cleveland—Weatherhead Co., 300 East 131st St., manufacturer of aircraft parts and fittings, plans installation of electric power equipment in connection with expansion in plant for production for War Department. Cost estimated about $420,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will be placed under way soon.

Pa., Philadelphia—Bureau of Yards and Docks, Navy Department, Washington, D. C., plans extensions and improvements in central power plant at Philadelphia navy yard, with installation of additional equipment for increased capacity. Work will be carried out during 1946 Federal fiscal year, effective July 1, and fund of $799,000 is being arranged for project.

R. I., Bristol—United States Rubber Co., 500 Wood St., Bristol, plans installation of electric power equipment in new two-story addition to local plant, about 110 x 160 ft, reported to cost over $125,000, with machinery. Project has a priority rating and erection will begin soon. Main offices are at 1230 Sixth Ave., New York, N. Y.

R. I., Providence—Narragansett Electric Co., 49 Westminster St., has preliminary plans under way for steam-electric generating staion on local site, to be carried out as a postwar project. It has not been announced if plant will be an extension to one of existing stations on Manchester St. and on South St., respectively, or an entirely new unit. Cost reported over $2,000,000, with turbine-generator, high-pressure boiler and auxiliary equipment. Philip D. Creer, 31 Benevolent St., Providence, is engineer.

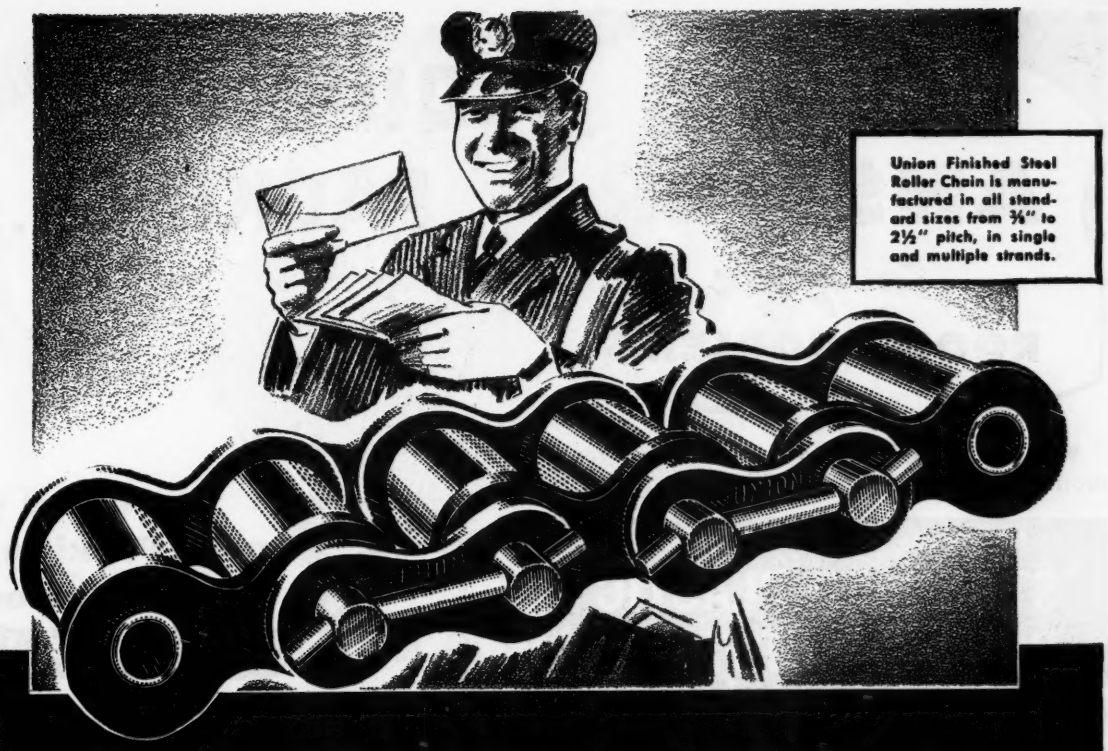
S. C., Rock Hill—Rock Hill Printing & Finishing Co., rayon printing, dyeing and finishing, plans installation of electric power equipment in new addition to mill at White and Laurel Sts., to be carried out as a postwar development. It will be two-story, about 40,000 sq ft floor space, and is estimated to cost over $400,000, with machinery. Plans will be prepared soon.

Texas, Raymondville—Central Power & Light Co., plans one-story addition to local ice-manufacturing plant, reported to cost over $50,000, with equipment. Proposed to begin work soon. Priority rating has been secured. Main offices are at Corpus Christi, Tex.

Wis., Antigo—Antigo Milk Products Co-operative, Inc., Otto Worth, manager, has made application for a priority rating for construction of new multi-story boiler house at plant, 63 x 100 ft, and 40 ft high, with installation to include boiler, pumps, coal and ash-handling apparatus and other equipment. No estimate of cost announced. Oppenhamer & Obel, Wausau, Wis., are architects.

Wis., Eau Claire—National Pressure Cooker Co., 1515 Ball St., manufacturer of canning and cooking utensils, plans installation of electric power equipment in new one and two-story additions, reported to cost close to $100,000, with machinery. Also will build addition to boiler house, with installation of equipment for increased capacity. Project has a priority rating and work is scheduled to begin soon. Magney, Tusler & Setter, Foshay Tower Bldg., Minneapolis, Minn., are architects.

Wis., Green Bay—Wisconsin Public Service Corp., Green Bay, will take bids in May for new addition to local Bayside steam-electric generating station, where large expansion program will be carried out. Installation will include new turbine-generator unit (to be furnished by Westinghouse Electric & Mfg. Co.), high-pressure boiler, stack and auxiliary equipment. Cost estimated about $3,000,000. Utility Engineering & Service Corp., 231 South LaSalle St., Chicago, Ill., is consulting engineer.



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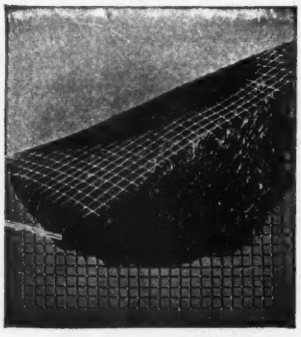

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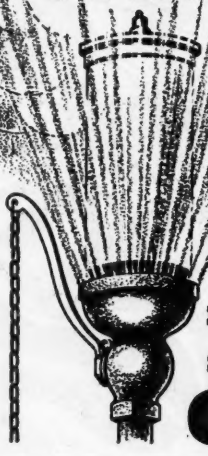

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Quaker Pacific Rubber Co.

San Francisco • Los Angeles

EXPLOSION PREVENTER

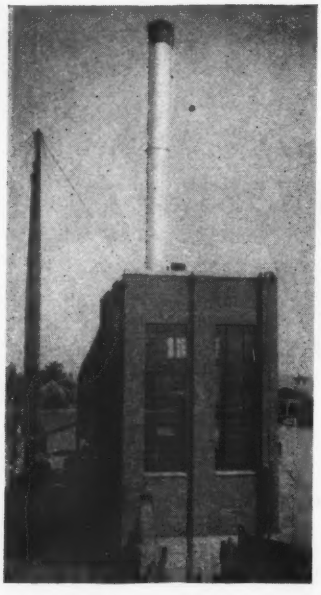
Postwar model . . . *but now!*

There's just one reason for putting a Flame Failure Safeguard on an oil or pulverized coal burner — to prevent an explosion. No control which does not react instantaneously to flame failure can provide full protection. It is the few seconds of delay lost between flame failure and fuel cut-off that charges the combustion chamber with potential destruction. Equipment that depends upon changes in temperature or in flame characteristics, such as electrical conductivity, must be ruled out in the dependable system. Only the surest control is worthy of the responsibility of protecting your property. Fireye is a *Photoelectric* Flame Safeguard. It is actuated by the direct light of the flame itself — but that is not all! Fireye is *photoelectric* in operation — does not depend on converting the light into heat in a mechanical gadget. Fireye sees the flame — acts instantly upon flame failure to cut off fuel and sound an alarm. Fireye mounts outside the boiler, looks through a window, is removed from destructive heat. Fireye is the flame safeguard of the future — proved and ready for you now.

Combustion Control Corporation • **Cambridge 42, Mass.**

District Offices in all Principal Cities

photoelectric fireye flame safeguard



HOW CONNERY CONSTRUCTION*
Holds Down Maintenance at
DUNN SULPHITE PAPER CO.

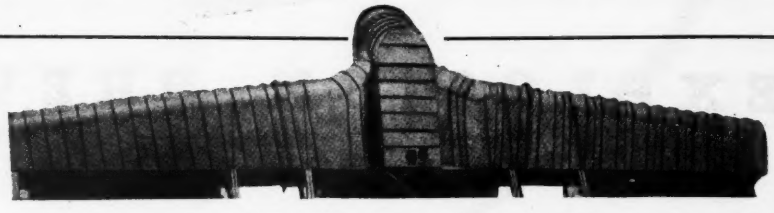
Taking a tip from hundreds of other industrial plants and central stations, the Dunn Sulphite Paper Co. at Port Huron, Mich., picked Connery Construction for the stack, breeching and flues of its new and highly efficient power station. For complete description of this plant see January, 1945, Power Plant Engineering.

Here, Connery Construction will eliminate the headaches that result from buckling, warping, loose joints. It will assure maximum contraction and expansion—step up efficiency of draft —prevent internal corrosion—help hold down plant maintenance expense.

Write for 36-page Connery Handbook. It shows how Connery's Expansion Stiffener makes stacks, breechings, flues and uptakes serve better and last longer; contains specification data; picture applications in different industries.

CONNERY CONSTRUCTION CO.
Second and Luzerne Sts., Philadelphia, Pa.

Get a CONNERY BID on:
STACKS
BREECHINGS
UPTAKES
HOPPERS
AIR DUCTS



*Connery Construction is electrically welded, with "V" stiffeners pressed into the metal; permits uniform expansion and contraction; won't warp or buckle.

STOP LEAKS
Damp Proof—Water Proof

Leaks, water seepage in concrete walls can be stopped instantly — permanently with FLEXTITE. This material will convert wet basements into bone-dry useful space. Will seal leaks against water pressure. Can be used in elevator pits, tunnels, dams, concrete water tanks, retaining walls. Efficient as a plaster coat for waterproofing and dampproofing.

Write for Further Information and Details

FREE TRIAL OFFER

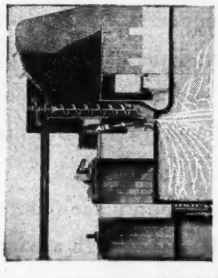
FLEXTITE

FLEXROCK COMPANY
3623-A Filbert St., Philadelphia 4, Pa.
Please send me complete FLEXTITE information . . . . details of FREE TRIAL OFFER—no obligation.
Name .....
Company .....
Address .....

FYR-FEEDER
MULTIPLE SPREADER STOKERS

BURN COAL LIKE OIL!

Save with FYR-FEEDER—Burn less coal—Cheaper coal—Local coals—Screenings—Coal Yard Sweepings, wet or dry—WET coal is no handicap.



FYR-FEEDER exclusively employs air JET coal PROPULSION

Fines burn in suspension, larger pieces are spread evenly over grate.

FYR-FEEDER increases boiler capacity—responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes fireman's work much easier—no banking losses.

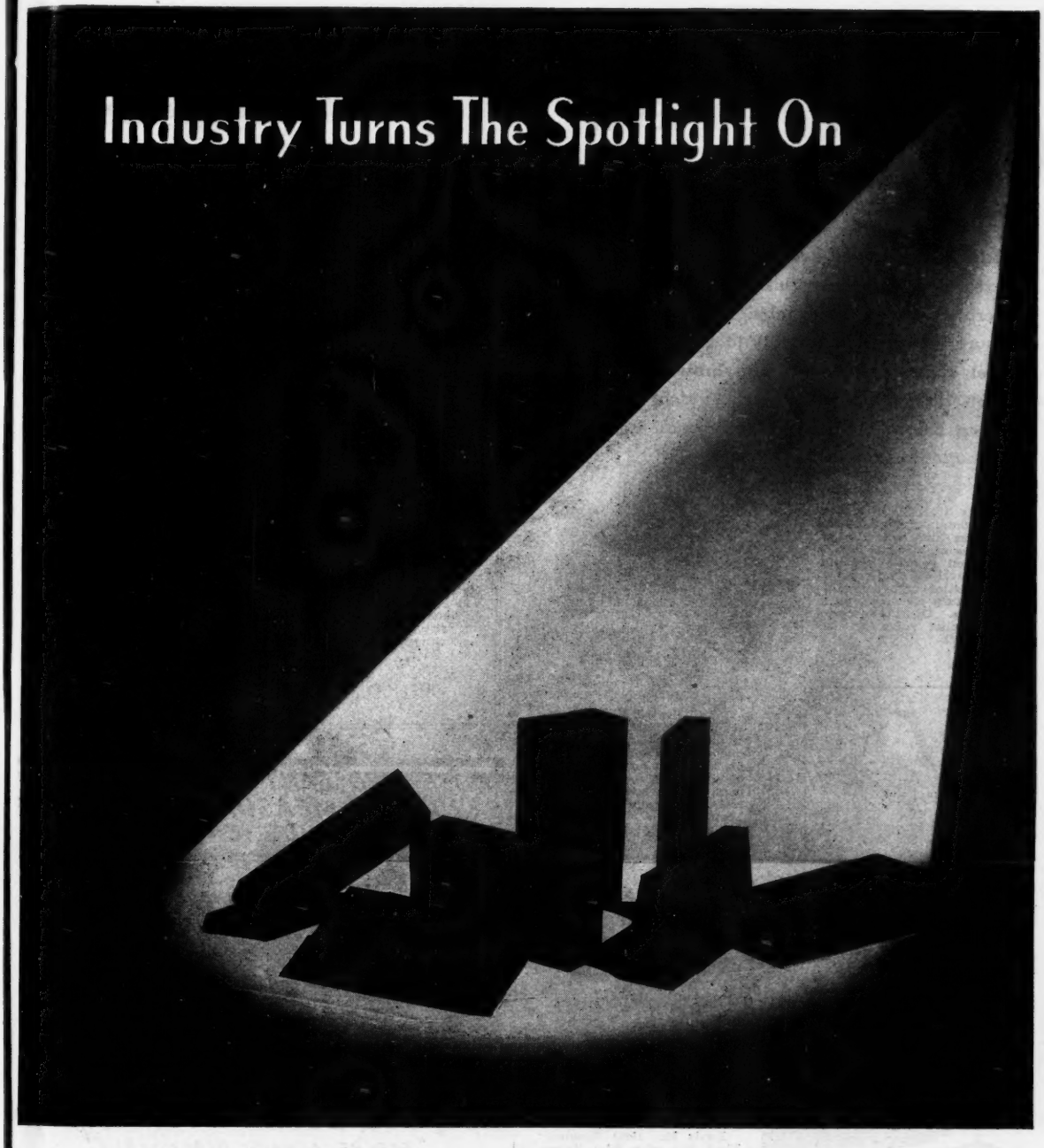
CHANGE OVER TO FYR-FEEDER NOW
Easily installed in minimum time

FYR-FEEDERS are built in sizes to burn from 300 to 12,000 lbs. coal per hour. If you are or expect to be in the market for automatic coal burning equipment

Wire or Write
FYR-FEEDER Stoker Division
AMERICAN COAL BURNER COMPANY
Engineers

22—19 E. Erie St. **Chicago 11, Ill.**

Industry Turns The Spotlight On



CRYSTOLON BRICK

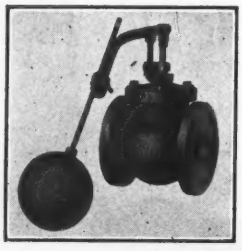
Wartime peak operation emphasizes CRYSTOLON Brick's outstanding quality—long, trouble-free service . . . a serviceability derived from these characteristics: (1) great refractoriness, (2) chemical stability, (3) resistance to abrasion, (4) resistance to the corrosive action of ash and the penetration of slag.

NORTON COMPANY — Worcester 6, Mass.

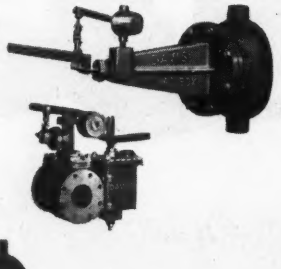
the *BEST ANSWER* to your LIQUID LEVEL CONTROL PROBLEMS

Years of experience designing and building float boxes, float and lever tank units, float and lever operated valves, and combinations of these units, assure you of Davis' ability to solve your liquid level control problems. The broad Davis line meets *any* service condition. Typical units are shown below. Bulletins describing all units will be mailed on request.

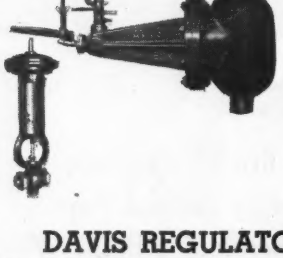
Davis No. 161D Float Box, for maintaining liquid level in tanks and receivers, regardless of whether flow is in or out of tank, has Dia-Ball packless, leak-proof transmission unit. Available with rotary stem and packing box. Operates control valve, pilot valve or electric switch.



Davis No. 60 Float Valve —single seat. For 125 lbs. hydraulic pressure. Globe and angle patterns. For use on the make-up line to an open tank. Maintains maximum desired level automatically. No hunting or water hammer.



Davis No. 164D Packless Float Box with explosion proof switch and No. 97SH Solenoid Valve with explosion proof case.



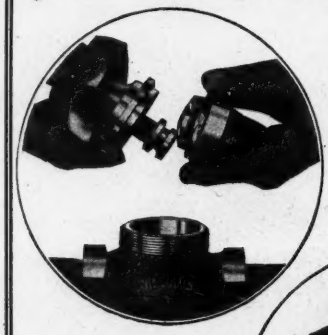
Davis No. 162D Packless Float Box with Pilot Valve and No. 14 Diaphragm Motor Valve. Operating medium may be air or non-corrosive gas at 25 to 40 lbs.

DAVIS REGULATOR COMPANY

2508 S. Washtenaw Ave. Chicago 8, Illinois

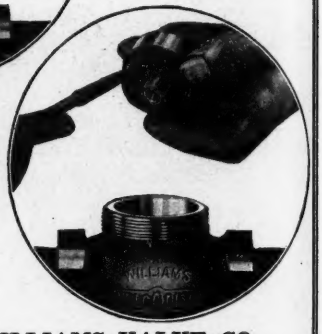
DAVIS REGULATOR COMPANY

Use VULCODISC *for trouble-free valve jobs*



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

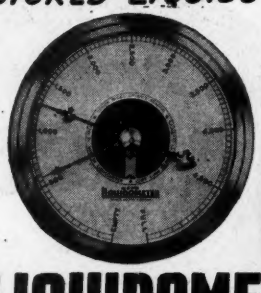
Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.



THE D. T. WILLIAMS VALVE CO.

Cincinnati, Ohio

THOSE WHO CAN'T AFFORD TO MAKE ERRORS IN MEASURING VALUABLE STORED LIQUIDS CHOOSE —



LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.

No pumps, valves, or auxiliary units needed to read them.

Models available for either remote or direct readings.

Accuracy unaffected by specific gravity of tank liquid.

Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

THE LIQUIDOMETER CORP.

36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

STOP RUST BEFORE RUST STOPS YOU!

$1,000,000,000 per year—*one thousand million* dollars . . . that's RUST'S annual "loot" from industry!

Your share? Actually, it's a lot more than you think—whatever your type of production. For Rust's "loot" is measured in depreciated machinery . . . in wasted time and materials . . . plus losses you can't even begin to calculate.

There's only one way "out." That's . . . *Stop Rust before it starts!* Stop it before it stops you.

Use Shell Tellus Rust-Preventive Oils to lubricate machines, wherever moisture is a factor. These Shell developed and perfected oils possess special rust-inhibiting qualities and, therefore, provide protection against the *formation* of rust.

Furthermore, *these oils have been developed without sacrifice in other important characteristics.*

Use the new Shell Ensis Rust-Preventives as protective coatings. They come in a complete line of oils, fluids, and compounds. The protective coatings formed range from thin, transparent oil films for use between machining operations to heavy, abrasion-resistant surfaces that stand up against weather and time.

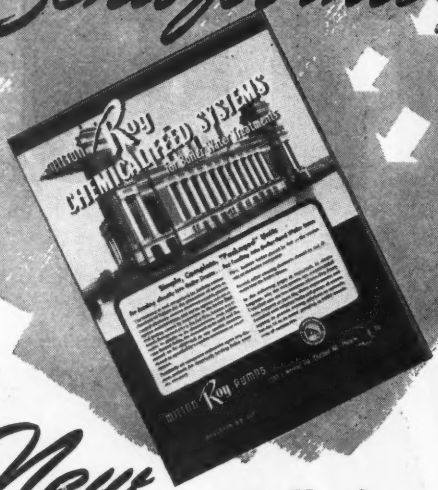
Call the Shell man now. Let him study your operation and show you how to "stop rust!"

Write, wire or phone: Shell Oil Company, Inc., 50 West 50th Street, New York 20, N. Y., or 100 Bush Street, San Francisco 6, Calif.

SHELL

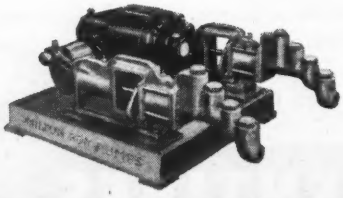
SHELL RUST PREVENTIVES
...OILS...FLUIDS...COMPOUNDS

Send for this



New . . . Bulletin on Boiler Water Chemical Treating Units . . . . . .

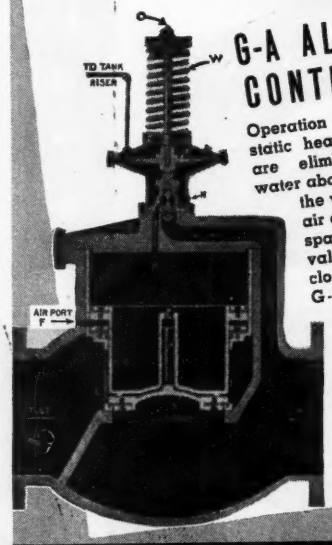
- Tells how to protect boilers against corrosion and pitting . . . prevent scale, control alkalinity, remove dissolved oxygen.
- Tells how Sodium Sulfite should be fed . . . how other chemicals should be fed . . . why two systems are used in combination for best results.
- Describes simple, complete "Packaged" units to meet above requirements . . . a brand new Milton Roy development.
- Contains selection tables from which to choose units of proper capacity for single or multiple boilers operating over a wide range of pressures and make up water requirements.
- This bulletin is "must" reading for every power plant operating engineer. Send for it.



MILTON Roy PUMPS
1337 E. MERMAID AVE., CHESTNUT HILL, PHILA. 18, PA.

NO WATER HAMMER WITH

G-A ALTITUDE CONTROL VALVES



Operation of these valves is by static head. Surges or shock are eliminated because the water above the piston cushions the valve in opening, while air drawn into the annular space through the port in valve body prevents valve closing too quickly.

G-A Altitude Control Valves come in sizes 2 in. to 36 in., in either globe or angle pattern. May be closed three ways. Write for your free copy of the G-A Catalog. It describes entire line.

GOLDEN-ANDERSON
VALVE SPECIALTY CO.
FULTON BUILDING, PITTSBURGH, PA.

Protect Your Boilers Against Pitting, Corrosion and Scale with

Magic
BOILER PRESERVATIVE

- This modern boiler preservative contains colloids that possess adsorptive properties. It holds all precipitates in suspension, while at the same time establishing a protective colloidal film on the metal to arrest pitting and corrosion. Its action is simple, safe, sure; helps your boiler produce more steam.

Write for Descriptive Bulletin

GARRATT-CALLAHAN CO.
Established 1904
OF ILLINOIS, 59 East Van Buren St, Chicago 5
OF NEW YORK, Inc., 1328 Broadway, New York City 1
OF CALIFORNIA, 148-156 Spear St, San Francisco 5

...TO MEET WARTIME EMERGENCIES

With steam power equipment everywhere being worked to limits of capacity these days, emergency calls for pressure tubing have been more numerous and urgent than in normal times. The war can't wait—neither can war-essential boilers and heat transfer equipment on land, sea and rails. Even the best of tubes sometimes have to be replaced more often nowadays due to prolonged, round-the-clock operation under extreme conditions.

As a leading tube manufacturer, B&W is called upon to supply many of these emergency replacements on short notice. A few examples cited here typify the urgency of such calls and how B&W was able to speed deliveries.

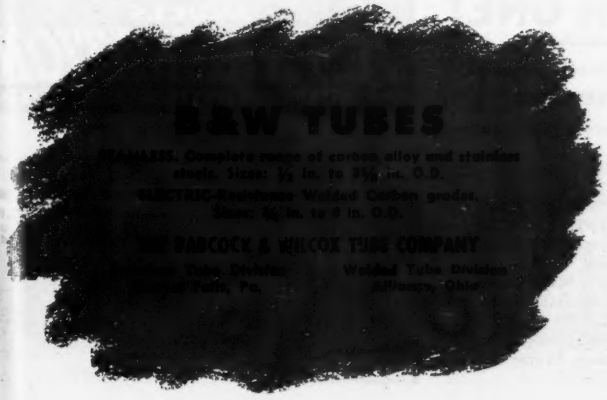
The reasons that enable B&W to meet these war-urgent emergencies are good reasons why you should specify B&W tubing for present and post-war needs for both welded and seamless pressure tubing. Consult B&W today.

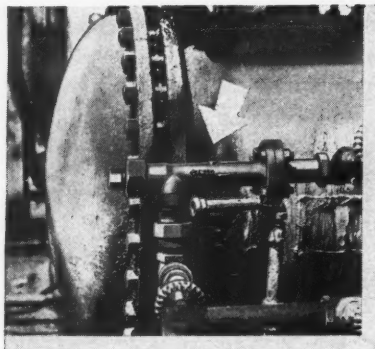
Example 1—A troopship ready for convoy needed 13 tons of seamless boiler tubes . . . 926 pieces of complicated design were rolled, bent and delivered by B&W in 4 days.

Example 2—Facing a shut-down, a municipal power plant phoned for 12—4" x .203" x 18' boiler tubes . . . two hours later, tubes were en route by railway express.

Example 3—A west coast shipyard phoned for six stud tubes for B&W header-type boiler . . . within 24 hours tubes were on a night plane and installed the following day.

Example 4—A phenol plant faced a bottleneck for lack of 5,220 lb. of stainless steel tubes . . . the required 16' and 18' lengths of B&W tubes were flown 600 miles by the Air Transport Command.

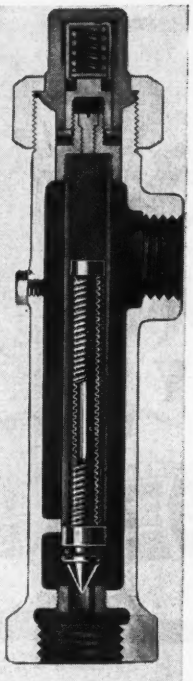




A steam trap and temperature control in one

It's the low cost Sarco liquid expansion trap, that is used by the hundreds in refineries, coal, chemical and other industries that have outdoor steam operations. It can't freeze.

Also in various forms, can be used as a steam injector, or a tank temperature control. Ask for Catalog No. 550.



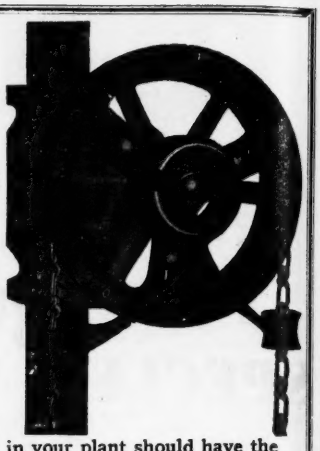
No. 87

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York 17, N. Y.
SARCO CANADA, LTD., 85 Richmond St. W., TORONTO, ONT.

179

For All "HIGH-UP" VALVES



Every overhead valve in your plant should have the easy, safe, instant control from the floor which Babbitt Sprocket Rims provide. . . . Babbitt Rims are low in cost; quickly attached; they save time, steam and accidents. Install them now. Write for descriptive folder.

BABBIT STEAM SPECIALTY CO.
South Water, Spring and First Sts.
New Bedford, Mass., U. S. A.

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

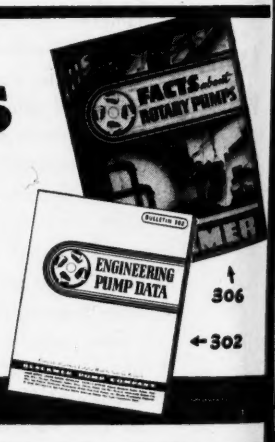
FACTS about ROTARY PUMPS

This bulletin tells you why and how

BLACKMER ROTARIES
are SELF-ADJUSTING FOR WEAR

WRITE NOW FOR
BULLETIN No. 306 — FACTS ABOUT ROTARY PUMPS
Bulletin No. 302 — Pump Engineering Data

BLACKMER PUMP COMPANY
2010 CENTURY AVENUE GRAND RAPIDS 9, MICHIGAN
Serving Industry for More Than 40 Years



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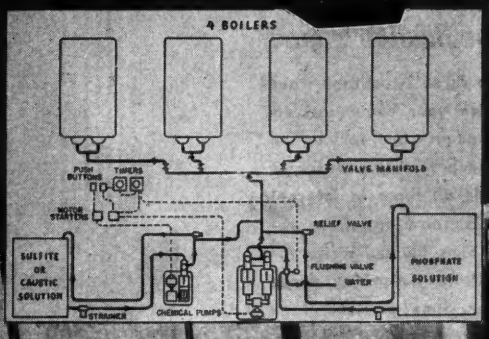
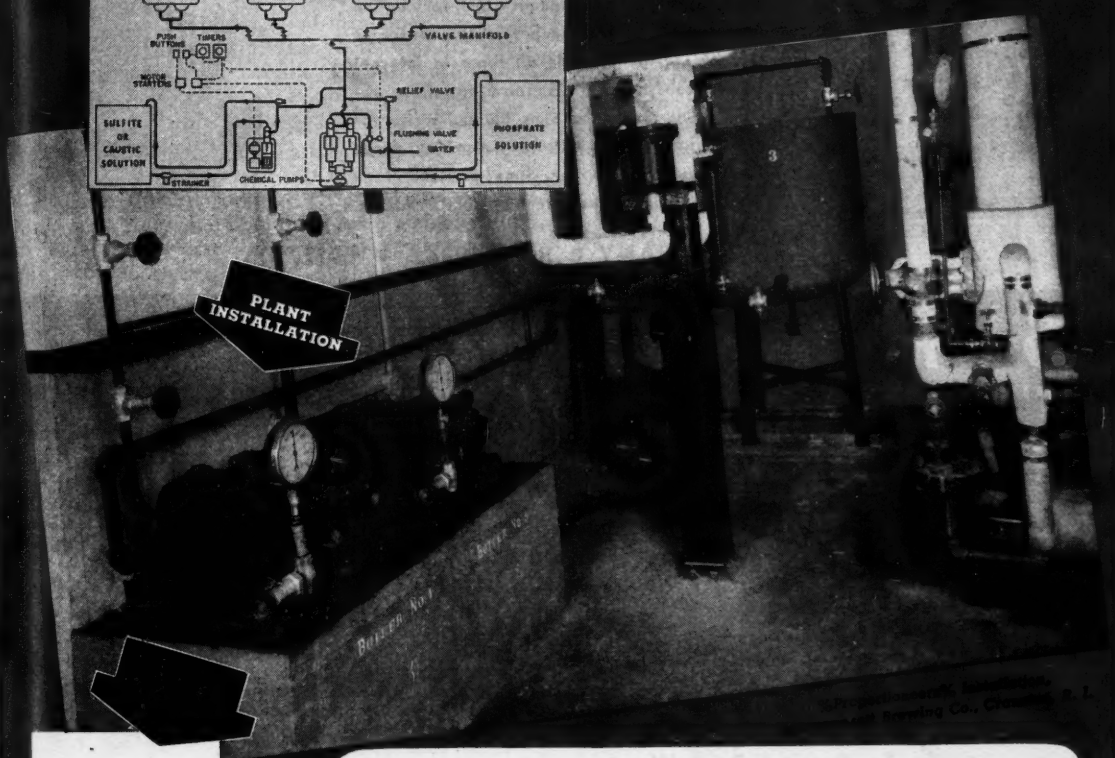
Working PRINCIPLE FOR Correct BOILER WATER CONDITIONING

FLOW DIAGRAM



PLANT INSTALLATION



BOILER WATER CONDITIONING WILL WORK FOR *You*

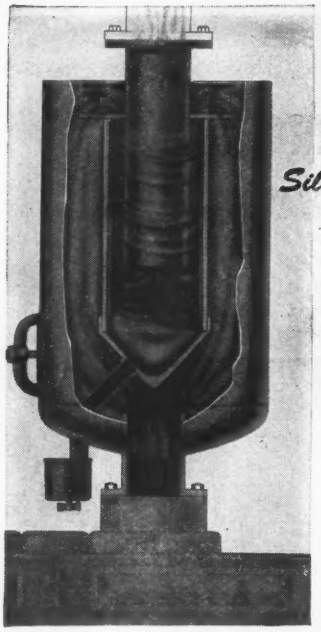
THERE IS A %PROPORTIONEERS% SYSTEM TO MEET EVERY WATER CONDITIONING PROBLEM

The success of your chemical treatment depends on strict adherence to an operating program. In many cases insufficient importance is given to the *method* and *regularity* with which the treatment is injected. By using the tried and proven %Proportioneers% system, you eliminate guesswork, assure accurate treatment, safeguard your boiler investment, improve heat transmission, save fuel and reduce costly shutdowns for repairs and cleaning.

Ask for Bulletin 1713

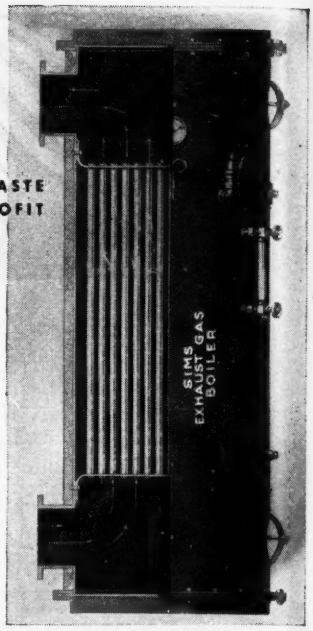
% PROPORTIONEERS, INC. %

WRITE TO % PROPORTIONEERS, INC.%, 46 CODDING ST., PROVIDENCE 1, RHODE ISLAND



Silence THE EXHAUST

Convert WASTE HEAT TO PROFIT



SIMS Offers Three Services to Your Internal Combustion Engine

● Illustrated here are three important ways to protect and enhance your engine investment. Sims Heat Exchangers are serving on land and sea to keep jacket cooling water at the safe temperature in all types of internal combustion engines Plan now to utilize exhaust heat through a Sims Boiler. Write for "Heat Recovery" Bulletin describing these two services and for Sims Cyclone type Silencer Bulletin, the latest of Sims Products.

THE SIMS COMPANY ● BOX 1096A ● ERIE, PA.

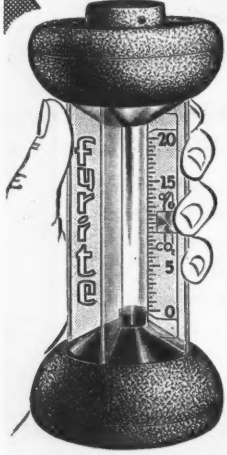
SIMS *Heat Recovery Products*

HEAT EXCHANGERS ● EXHAUST GAS BOILERS ● ENGINE SILENCERS ● STORAGE WATER HEATERS
OIL HEATERS ● OIL COOLERS ● FEED WATER HEATERS AND UNIT TYPE PULVERIZERS

FUEL CONSERVATION BEGINS IN YOUR BOILER ROOM

USE THE PORTABLE

FYRITE CO_2 ANALYZER



To Reveal Fuel Waste INSTANTLY!

The FYRITE Indicator makes accurate CO_2 analysis of the flue gases easy—and CO_2 analysis is the standard accepted method for determining the percentage of fuel wasted up the stack due to needless excess air being drawn through the furnace. The FYRITE quickly points the way to adjustments and repairs necessary to secure efficient fuel utilization. It is simple and rugged; has no valves, clamps, or leveling bottle; no glass parts or batteries; requires no skill or technical knowledge.

Oxygen Indicator designed on same principle also available. Send for Leaflet 700.

$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

HEATING SERVICE DIVISION
BACHARACH
Industrial Instrument Co.
7000 BENNETT ST.
PITTSBURGH 8, PA.

RETURN THIS COUPON FOR BULLETIN 341 ON FYRITE CO_2 INDICATOR

NAME

ADDRESS

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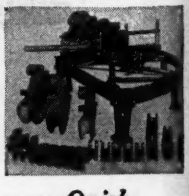
12 types from which to select; hand operated capacities:- ¼ to 6" inclusive; motor operated:- ½ to 8" inclusive. Now indispensable to contractors, shipbuilders, ordnance plants and thousands of others. These machines will be essential also in industrial conversion after the war.

12,000 *customers—and more—can testify to the indispensability of "American" machines. Here are a few users:* Bureau of Ships, Wash., D. C.; Henry J. Kaiser Co., Calif.; Pacific Bridge Co.; Bethlehem-Hingham Shipyards; Hercules Powder Co.; Stone & Webster; E. I. Du Pont de Nemours & Co.; Crane Co.



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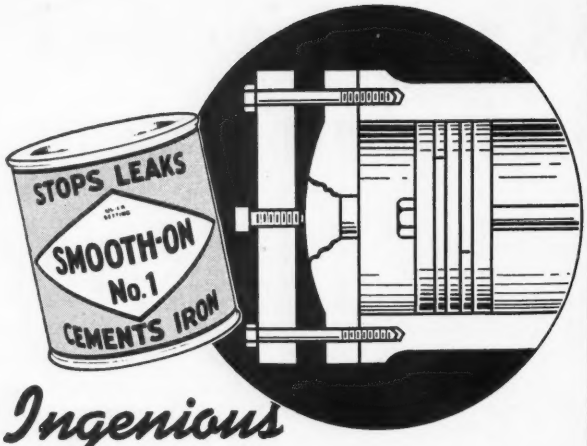

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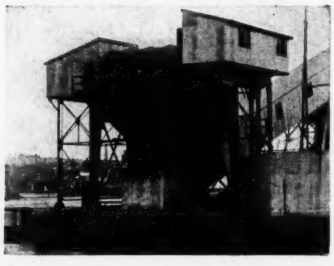

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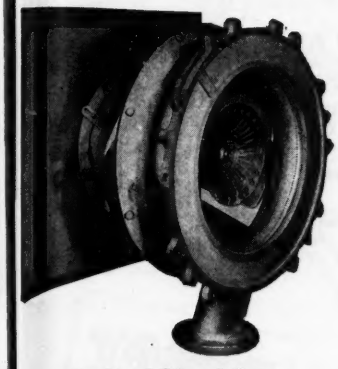

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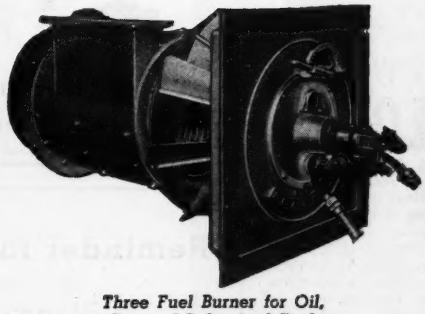

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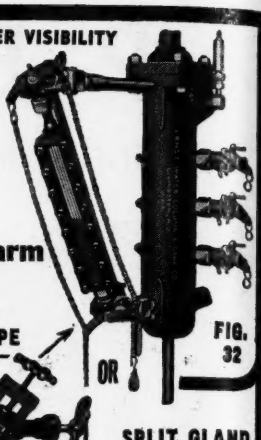

FIG. 32

OR

SPLIT GLAND TYPE

FIG. 1

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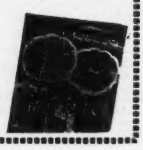

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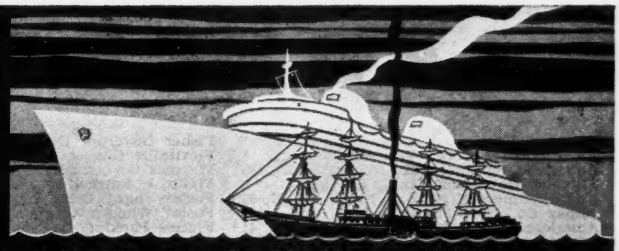

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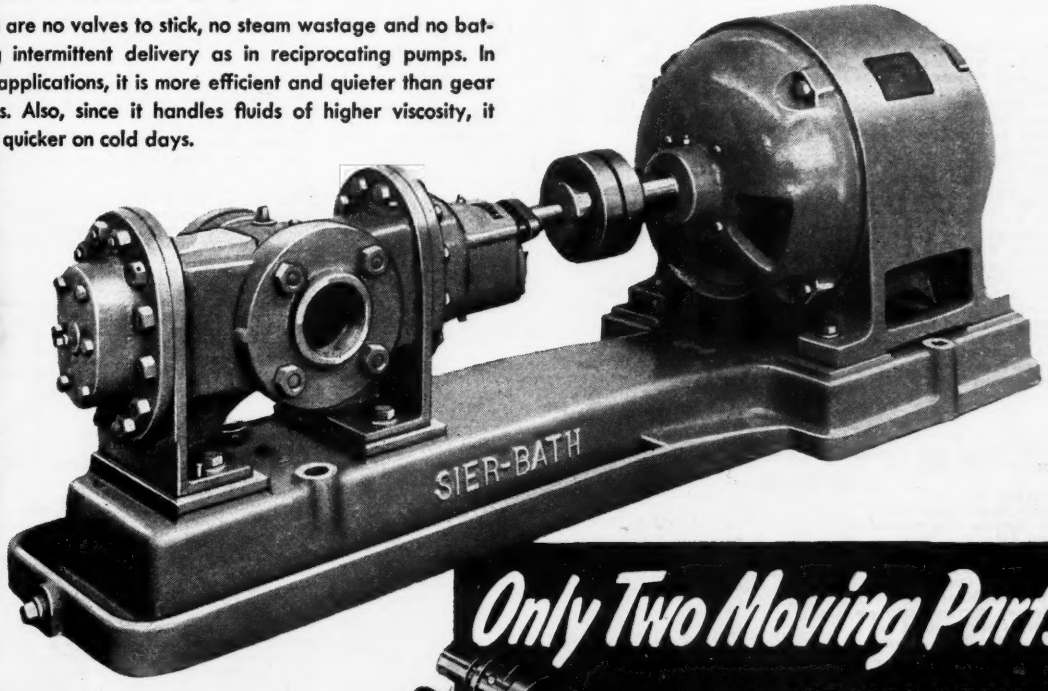

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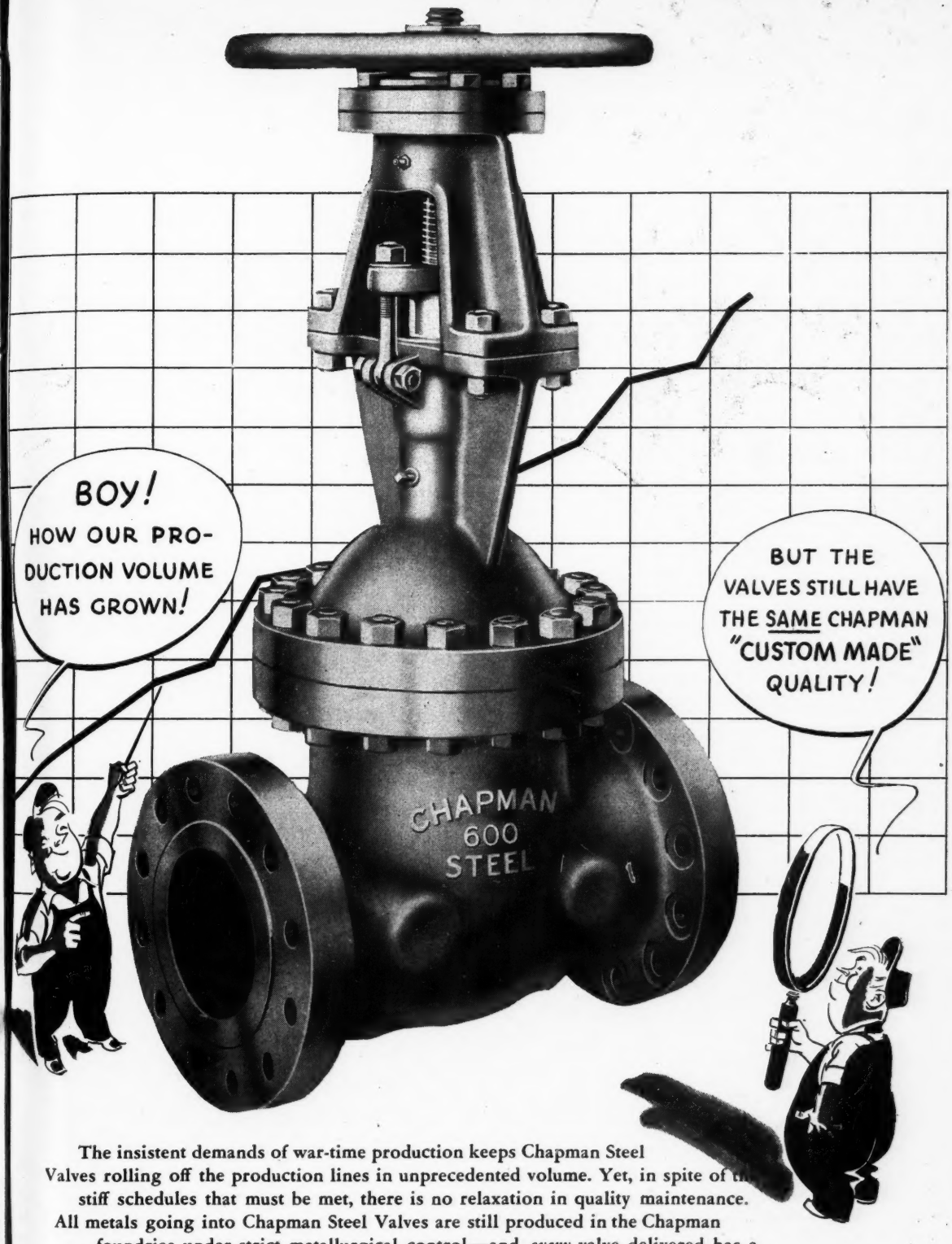
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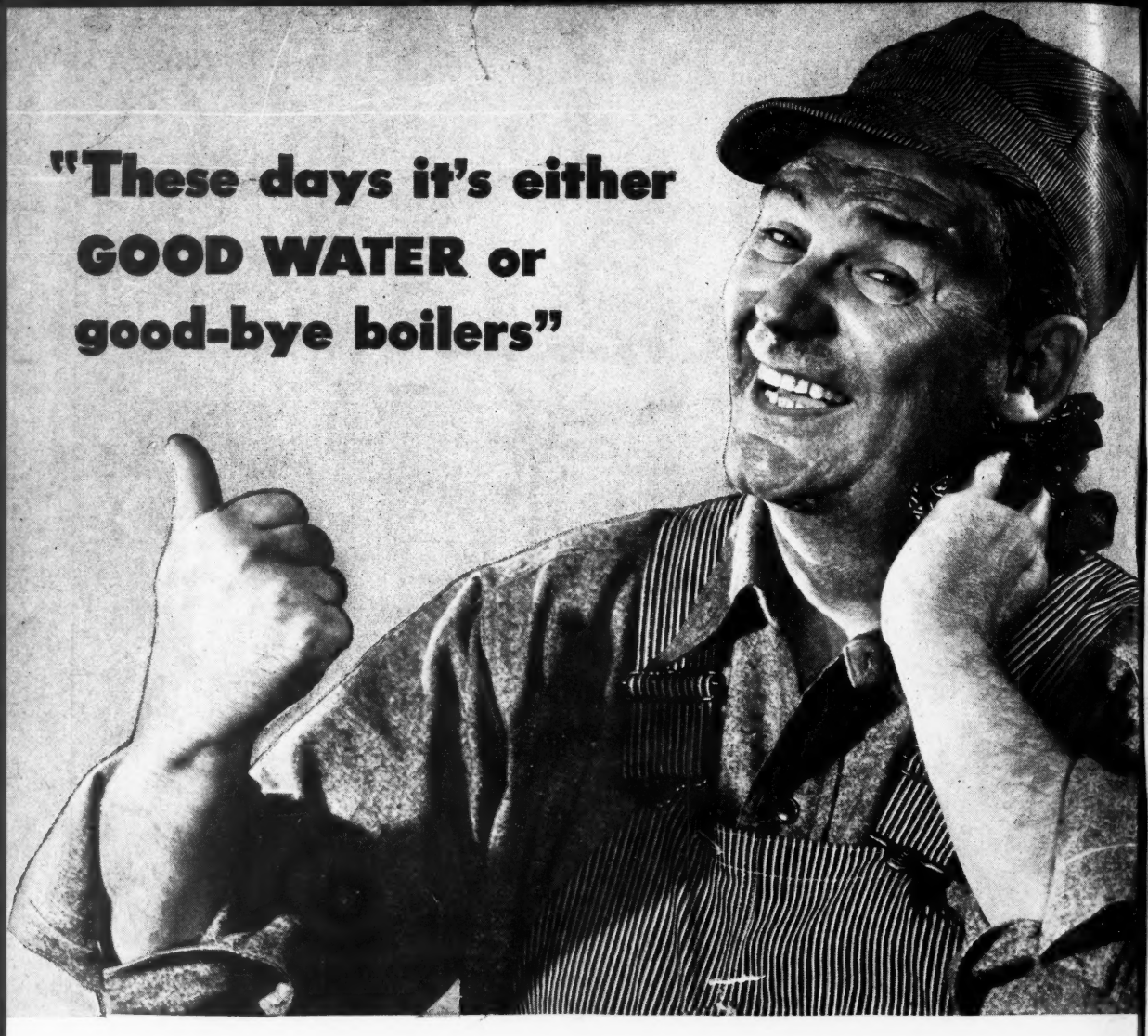

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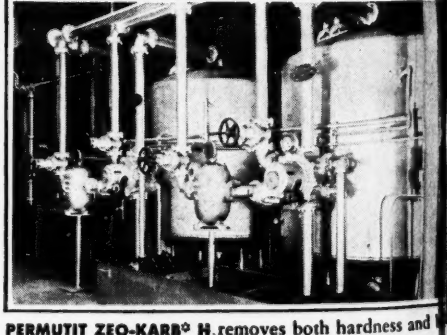

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